1998

Protection of wetlands in the Grand River watershed from non-point source pollution (Ontario)

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Protection of Wetlands in the Grand River Watershed from Non-Point Source Pollution

by

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A thesis
submitted to the Department of Geography and Environmental Studies
in partial fulfilment of the requirements
for the degree of Master of Environmental Studies

Wilfrid Laurier University
1997

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ABSTRACT

The purpose of this study is to assess the strengths and weaknesses of the municipal official plans to protect provincially evaluated wetlands from activities causing non-point source pollution within the Grand River watershed. An integrated framework for policy analysis involving both an evaluative and normative approach assists in determining the value of wetland protection policies and recommends future actions to guide decision-making on development adjacent to wetlands.

Specifically, the objectives include (a) to locate, identify and measure the total wetland area, class and number of wetlands in the Grand River watershed on an upper- and lower-tier municipal basis; (b) to evaluate the extent of adjacent areas contributing surface water contamination to the wetlands in the Grand River watershed on an upper- and lower-tier municipal basis and by individual municipalities, thus establishing the risk due to degradation from non-point source pollution; (c) to determine the pressures of development by examining the changes in population and dwelling density from 1986-1994; (d) to identify the strengths and weaknesses of municipal governments from the viewpoint of the staff to implement municipal policies on wetlands; (e) to review and assess municipal official plans for wetlands, natural areas or hazard land policies to determine whether the municipalities effectively protect wetlands; and (f) to provide insight, based on this research, to guide protection or rehabilitation of wetlands at risk from non-point source pollution.

Mapping showed that 7.2 % of the watershed is covered by 220 named and evaluated wetlands. Seventy-one percent are provincially significant and distributed within three-quarters of the lower-tier municipalities, mainly towns/townships. Large portions of these natural areas are shared by neighbouring municipalities. All municipalities within the watershed experienced a growth in population and an increase in dwelling density during the period of wetland policy implementation. The largest population and dwelling density increases occurred in cities and villages or their adjacent municipalities. Generally, official plans policies throughout the watershed needs some improvement. Regional municipalities had the most adequate, while villages tended to have the least effective policies, given the lack of wetlands in these municipalities.

The Grand River Conservation Authority and the Ontario Ministry of Natural Resources are considered to be the agencies with the expertise and strength to protect wetlands. Half of all respondents to the municipal staff survey do not have the resources to effectively protect wetlands due to inadequate finances and a lack of staff expertise in environmental issues. Disinterested landowners and a lack of understanding the value of wetlands are also impediments to wetland protection. Education and awareness programs for the public were considered beneficial. The thesis concludes with several recommendations which may assist the Province and municipalities to develop planning initiatives to effectively and efficiently protect the remaining wetlands in the Grand River watershed.

ACKNOWLEDGEMENTS

To my mentors who advised, challenged and supported these endeavours.

Firstly, I would like to thank my advisors, Dr. Bob Sharpe at Wilfrid Laurier University and Dr. George Mulamoottil, University of Waterloo for their patience, assistance, encouragement and advice provided to me throughout this time. Secondly, I appreciate the research and financial support provided by Elizabeth Snell of Snell and Cecile Environmental Research and Environment Canada. To the planners, clerk-treasurers and reception staff of all the municipalities within the Grand River watershed, the Grand River Conservation Authority and Ministry of Natural Resources District offices, without their information and help, this thesis would not be.

I would like to acknowledge Wilfrid Laurier University for their financial assistance provided to me through a scholarship and teaching assistantships. To Lynne Elliott and Marko Dumancic of the University of Waterloo Mapping, Analysis and Design Department, my gratitude for their tolerance of so many questions on the GIS and to Bob Pepper, whose unfailing humour prevailed throughout the technical difficulties with the computer cartography. I also must thank the Waterfront Regeneration Trust for their financial support as a Research Assistant and the Soil and Water Conservation Society, for their recognition, both at the provincial and international level.

Finally, this accomplishment could not have been met without the faith and support of my family.

... and to the wetland type for which I am named.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

CELA: Canadian Environmental Law Association

CSPS: Comprehensive Set of Policy Statements

FON: Federation of Ontario Naturalists

H-N : Regional Municipality of Haldimand-Norfolk

H-W: Regional Municipality of Hamilton-Wentworth

NAWCC: North American Wetlands Conservation Council

OMNR: Ontario Ministry of Natural Resources

OMAFRA: Ontario Ministry of Agriculture, Farming and Rural Affairs

OMMA or OMMAH: Ontario Ministry of Municipal Affairs and Housing

OWPS: Ontario Wetlands Policy Statement

PPS: Provincial Policy Statements

Water.: Regional Municipality of Waterloo

CHAPTER 1: INTRODUCTION

Wetlands have been widely recognized as providing numerous environmental, economic and social benefits including maintaining and improving water quality, reducing flood damage and providing habitat for plants and animals (Frayer, 1991). Although the economic benefits are difficult to quantify, it has been estimated that the ecological functions of wetlands have resulted in hundreds of millions of dollars annually in reduced infrastructure costs (Government of Ontario, 1997). Despite their value, most of the original wetlands in southern Ontario have been lost or severely degraded since settlement (Snell, 1987). Changes to wetlands and their functions have occurred due to drainage for agricultural purposes, filling for residential and industrial development, dredging and filling of lakeshore wetlands for cottage and marina development, and from waste or non-native species invasion (Lemay and Mulamoottil, 1984). Cumulatively, such changes have reduced the resilience of ecosystems and the species within them to further changes, whether those changes are the result of urbanization, pollution, disease, non-indigenous species or natural disturbance (Government of Ontario, 1997). On-site securement programs may protect these ecologically sensitive areas; however, the success of these programs are limited due to overland run-off from agricultural practices, urban drainage and waste disposal sites (Snell, 1992). Continued losses may have serious implications for the health of Great Lakes' watersheds.

Concern about wetland loss has grown in recent years. Since 1975, a wetlands management program has been developed and implemented by the Province of Ontario. Protection is based on the use and enforcement of laws, regulations and policies at the provincial and municipal level. However, it is critical to properly assess wetland features and

functions in context with the decision-making process, since changes to wetland features and functions are insufficiently documented following policy implementation (Dodge and Kavetsky, 1994). For the purposes of this study, policy is defined as a "collection of principles which indicates intended and acceptable activity or direction for an organization or government" (FON, 1987). Numerous factors have and continue to promote wetland degradation including science and information deficiencies, imbalances in the distribution of costs and benefits of wetland conservation, inadequate planning systems, policy conflicts and institutional weaknesses (Dugan, 1990; Maltby, 1991). Innovative assessment and planning is required for improved wetland protection and management. To improve decision-making affecting wetlands, a new approach is needed based on a functional analysis of the policies.

The new approach should incorporate a balance of environmental, economic and societal needs. Maltby et al. (1994) recommended that decision-makers should develop policies of wetland protection to meet human and wildlife needs. Such policies would require procedures based on research to support their implementation. Maltby et al. (1994) also determined that institutional deficiencies weakened an effective wetlands protection program. Problems included (a) a lack of integration among different planning agencies; (b) inadequate planning or management systems; (c) shortage of experienced and suitably trained professionals; (d) poorly or non-enforced legislation; and (e) insufficient funding levels. He concluded that until wetlands receive full recognition of their roles, these natural areas will continue to be degraded, not only through physical means, but also through poor decision-making. A method to develop effective policies through an analysis of these factors

would be useful to recognize and include all impacts.

1.1 An Integrated Framework for Policy Analysis

Policy analysis is "an applied social science discipline which uses multiple methods of inquiry and argument to produce and transform policy-relevant information that may be utilized in political settings to resolve policy problems" (Dunn, 1981). Analysing policies produces and presents information to improve the basis upon which policy-makers can make decisions. Quade (1975) determined that the process implied the use of intuition and judgement. Policies can be examined by breaking them down into their component parts, assessing all parts and then rebuilding the parts into new alternatives. Analysis activities can include research to provide insights into an anticipated issue or to evaluate a completed program. Some policy analyses "are informal, involving nothing more than hard and careful thinking, whereas others require extensive data gathering and elaborate calculations employing sophisticated mathematical processes" (Quade, 1975).

The scope and methods of policy analysis are partly descriptive and partly factual. Information is gathered about the causes and consequences of policies necessary for understanding societal problems. On this basis, policy analysis "cannot be successfully practised within the boundaries of traditional social science disciplines that emphasizes development and testing of general descriptive theories" (Dunn, 1981). Coleman (1972) found that complex policy problems do not recognize traditional disciplinary boundaries, as general theories rarely apply to specific policy contexts, which often fail to provide information that permits policy-makers to control or manipulate policy processes. Policy analysis seeks to use and combine information and methods from several disciplines,

producing policy-relevant knowledge to solve problems in specific political settings. The aim of policy analysis is to evaluate as well as advocate, by producing facts to construct values and preferred courses of action.

Three approaches to policy analysis are: (1) evaluative; (2) empirical; and (3) normative. The evaluative approach refers to facts which can determine the worth or value of a policy, by testing whether a problem has been solved. Empirical approaches mean 'cause or effect', where facts may limit or enhance the understanding of values. Normative approaches are actions, when adopted, that produce information to promote advocacy. Social science has avoided evaluative and normative approaches because of the difficulties of separating facts and values in scientific disciplines (Dunn, 1981). However, policies which try to balance environmental, economic and social benefits, often cross the threshold of the disciplines on social science with the disciplines of science. A framework capable of integrating several disciplines and types of information would be required to carry out a functional policy analysis on wetlands.

Dunn (1981) described an integrated framework for policy analysis whereby policy analysis may be viewed as a process of inquiry involving five policy-informational components manipulated by using six policy-analytic methods. The use of policy-analytic methods (problem structuring, forecasting, monitoring, evaluation and recommendations) permits the policy analyst to change one type of information into another; such as factual into descriptive. Information and methods are interdependent, linked in a process of change involving 'policy-informational conversions.' Policy problems, alternatives, actions, outcomes and performances are altered by the appropriate use of policy-analytic methods.

Three forms of policy analysis are (1) prospective, where the production and manipulation of information occurs before policy actions are initiated and implemented; (2) retrospective, where the production and manipulation of information occurs after policy actions have been taken; and (3) integrated, combining the production and change of information both before and after policy actions have been taken (Dunn, 1981).

The integrated framework for policy analysis is a comprehensive form that is multidisciplinary and useful for studying the strengths and weaknesses of policies, at any time in the policy-making process. In order to devise a functional policy analysis of wetland protection, planning authorities must be able to assess the possible impacts that development may have on a wetland. The primary means of achieving this may be through the integration of various sources of data. A diagram of the integrative policy analysis framework used in the thesis is shown in Figure 1.0.

Policy-making for planning in the Province of Ontario is guided by the *Planning Act*. It enables municipalities and planning boards to make decisions regarding land-use planning within a legislative framework. Under the *Planning Act*, the land-use planning process sets out a distinct framework for the development of environmental, social and economic goals and objectives for the municipalities. A proactive comprehensive policy approach in the land-use planning process is preferred to ad hoc policy approaches, as it is more desirable to prevent the creation of problems and to plan for potential conflicts than to react to them at a later date (OMNR, 1992). One of the most effective mechanisms to help minimize the creation of new problems is the land-use planning process at the official plan or policy level (OMNR and OMMA, 1992). The official plan maps out the growth of the region, county,

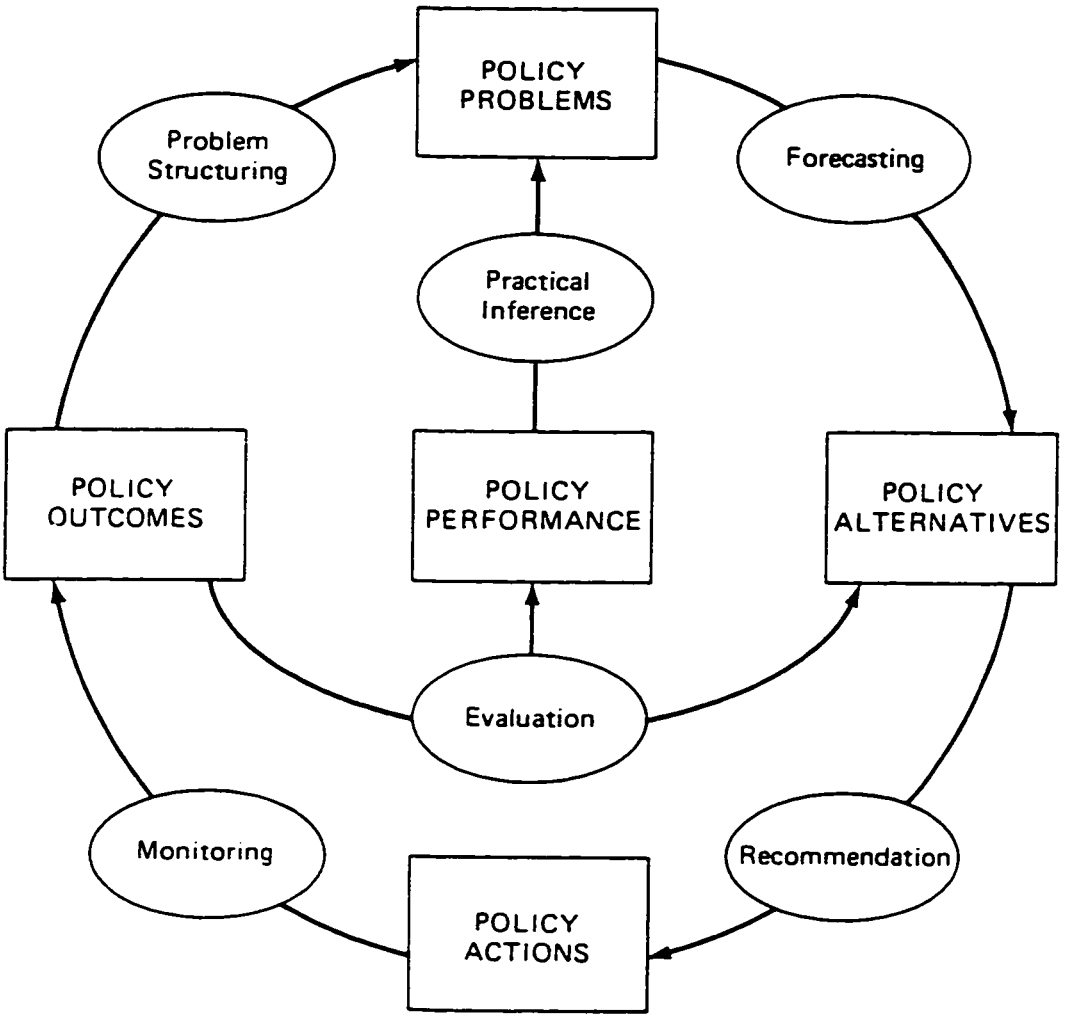


Figure 1.0: An Integrated Framework for Policy Analysis (Dunn, 1981)

city, town, township or village for a given period of time and acts as a 'blueprint' for the physical development of the municipality. This forecasts any new development permitted, the services to be implemented, as well as setting out where and in what stages these areas will be developed.

Official plans are implemented through (a) zoning bylaws; and (b) site plan control exercised over certain development by setting specific requirements for the physical design and layout of the site (OMMA, 1992). Protective zoning is a term that refers to any designation within the official plan that limits development on the parcel of land to which it applies. Since the *Planning Act* is not prescriptive, but is enabling legislation, designations limiting development may change from one municipality to another municipality (OMMA, 1992). For the Grand River watershed, the difficulty of being governed by upper- and lower-tier levels of municipal government is that the use and effectiveness of wetland protection policies may differ due to the distribution of wetlands and the acceptability of provincial guidelines. Protective zoning designations include wetlands, conservation lands, hazard lands and open space. To ensure that natural areas are protected, every municipality should zone such areas. The optimal time to initiate protective zoning measures is at the beginning of the review of the municipal official plan and as such, insights from assessing the strengths and weaknesses of policies could act as an incentive for some municipalities to review their official plans. Providing such an incentive, would mean acquiring a knowledge of what is currently happening in wetland protection, the status of wetlands in the watershed, the impacts from development and an assessment of existing protection policies in the official plans.

1.2 Problem Statement

The purpose of the study is to evaluate the status of wetlands in the Grand River watershed and assess the policies of the municipalities from the perspective of their adequacy to protect wetlands from non-point source pollution and the pressures of development impacting adjacent lands. A survey of the municipal staff is undertaken to determine staff and council experience with and attitude towards wetlands. Results are used to determine institutional limitations of policy implementation. With increasing awareness, policy-makers and planners can ensure that impacts from development are considered with the surrounding wetland ecosystems. An integrated framework to analyse the policies by combining normative and evaluative approaches with an understanding of the impacts due to non-point source pollution should support effective wetland protection policies and planning.

The primary objective of the thesis is to assess the strength and weaknesses of environmental policies within official plans to protect wetlands from impacts from non-point source pollution for the municipalities within the Grand River watershed. Non-point source pollution is defined as sediment and other associated contaminants which reach a water source due to erosion (Draper and Bos, 1994). Such contamination is caused by urban storm run-off, agricultural practices, liquid and solid waste disposal, shoreline filling, extractive operations, forestry and erosion (Environment Canada, 1986). While very significant in its cumulative effect, it is often barely perceptible because of its spread-out nature both in time and space (Snell, 1992). Dickinson et al. (1991) determined that non-point source pollution originates from a small proportion of the landscape and its control is

more cost-effective if measures are targeted to the problem areas. To target the areas of concern, the landscape and development factors influencing the erosion of the sediment and deposition overland to the wetlands must be combined. Based on the results, generalizations can be made which may be applied to comprehensively guide development of official plans.

1.3 Thesis Objectives

The specific objectives of this study are:

(a) to locate, identify and measure the total wetland area, class and number of wetlands in the Grand River watershed on an upper- and lower-tier municipal basis and by individual municipalities;

(b) to evaluate the extent of adjacent areas contributing surface-water contamination to the wetlands in the Grand River watershed on an upper- and lower-tier municipal basis and by individual municipalities, thus establishing the risk due to degradation from non-point source pollution;

(c) to determine the pressures of development by examining the changes in population and dwelling density from 1986-1994 in the Grand River watershed on an upper- and lower-tier municipal basis and by individual municipalities;

(d) to identify the strengths and weaknesses of municipal governments to implement policies on wetlands from the viewpoint of staff;

(e) to review and assess municipal official plans for wetland, natural areas or hazard land policies to determine whether the municipalities have clear goals and objectives to protect wetlands; and,

(f) to provide insight, based on this research, to guide protection or rehabilitation of wetlands at risk from non-point source pollution.

1.4 Thesis Organization

Chapter 2 is a review of the evolution of wetland policies and watershed approach for wetlands protection to describe the value of wetlands and the need for protection policies in Ontario. In Chapter 3, the research methods used in this study, including the technical

aspects of the geographic information system and non-point source model, collection of the population and dwelling density data, a description of the survey of municipal staff and assessment of the official plan policies are outlined. Chapter 4 discusses the wetland assessment including non-point source pollution contributing areas and the pressures as indicated by changes in population and dwelling density within the watershed, while Chapter 5 evaluates the results of the staff survey and the municipal official plan policy review. Chapter 6 provides an analysis and discussion of the policies in terms of the wetlands. Chapter 7 contains the conclusions and lists several recommendations.

CHAPTER 2: REVIEW OF THE EVOLUTION OF WETLAND POLICY AND WATERSHED APPROACH TO WETLANDS PROTECTION

2.1 Importance of Wetlands

Wetlands occupy a transitional position between terrestrial and aquatic ecosystems or land with fresh, brackish or saline waters (Maltby, 1991). The ecosystems that develop on such lands are dominated by the persistent presence of excess water, although wetlands may be permanent, seasonal or temporary (Tarnocai, 1981). Four types of wetlands include bogs, fens, swamps and marshes (OMNR, 1992). Several classification systems also recognize shallow open water such as potholes, sloughs and ponds, as well as shoreline areas (NAWCC, 1991).

For the purposes of the thesis, the term wetlands is defined as:

> *lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. In either case, the presence of abundant water has caused the formation of hydric soils (soils where there is an abundance of moisture) and has favoured the dominance of either hydrophytic or water tolerant plants. The four major categories of wetlands are swamps, marshes, bogs and fens...lands being used for agricultural purposes that are periodically 'soaked' or 'wet' are not considered to be wetlands in this definition* (OMNR & OMMA, 1992b).

The perception of wetlands as waste lands or having less value and available to be converted to other more productive uses has caused millions of hectares of wetlands across Canada to be drained or filled for agriculture, housing and industrial growth and dumpsites (NAWCC, 1991). Canada, which supports one-quarter of the world's wetlands, has experienced a substantial loss of wetlands since settlement began (NAWCC, 1990). Yet, it is now known that wetlands perform important ecological and hydrological functions with a wide range of benefits. Efforts to protect wetlands are increasing, as are the pressures to

convert them. Governments try to balance the needs for protection and development through their management decisions as to when and where wetland alteration will be permitted and mitigation required. At the same time, those concerned with wetlands loss, expect a certain level of predictability in wetland management and policy decision-making. To establish consistency in the management process, a coherent framework for linking current wetland management and regulation is needed (Kentula et al., 1992).

Approximately 14 % of Canada is covered in wetlands (Environment Canada, 1986). The conflicts between wetland conservation and use is largest in southern Canada, given the pressures of population, agriculture and development. Drainage for agricultural purposes, urban and industrial growth and recreational development have resulted in the disappearance and degradation of wetlands at an ever increasing rate (Lynch-Stewart, 1983; Snell, 1985). Eighty-five percent of all wetlands lost in Canada were lost to agricultural drainage; 9% due to urban/industrial expansion and 2 % to each of recreation development, hydro-electric development or lake level management, forestry and peat harvesting (Wildlife Habitat Canada, 1991). Southern Ontario, having the highest population density and most arable agricultural land in Canada, has experienced the greatest land use pressure.

It has been estimated that the pre-settlement wetland area in southern Ontario, prior to the 1800s was approximately 2.3 million ha (Cox, 1972; Bardecki, 1981; and Snell, 1987). During the 1960s to the 1980s, 5.2 % of wetlands in Ontario were converted to other land uses at a rate of 2, 619 ha per year (Snell, 1987). Almost three-quarters of the original wetlands in southern Ontario have already been lost (OMNR, 1992) with the original wetland area reduced by 61 % overall, and by 68 % south of the Precambrian Shield (Snell,

1987). The southwestern counties of Lambton, Kent, Huron, Simcoe and Middlesex counties accounted for 40 % of the recent decline. Much of the eastern Lake Erie shows a decline of 60-80% with other areas in the Grand River watershed experiencing losses of 20-60 % (Snell, 1987). At present, 29.2 million hectares of wetlands remain in Ontario covering 33 % of the land area, mainly in northern Ontario (NAWCC, 1993).

It has been determined that agricultural land-use change is the major cause of wetland conversion (Bardecki, 1981; Snell, 1987). After the 1940s, many wetlands were drained to meet the demand for available agricultural land. The *Ontario Drainage Act* and the *Tile Drainage Act* encouraged the practice of land drainage. Drainage is the act of removing excess water from the surface or subsurface of the soil by a system of buried perforated drains and pipes. The *Ontario Drainage Act* and the *Tile Drainage Act* provided landowners with funds, through interest free loans and subsidies, to construct and maintain drainage systems. Extensive tile and ditch drainage projects were constructed, paid for by the farmers and the Province. Grants, loans, subsidies and tax incentives are all mechanisms favouring activities that results in wetland degradation and loss (Maltby et al., 1994). In southwestern Ontario, over 90 % of the wetlands were lost, mainly converted to agricultural use (Snell, 1987). Although urban growth affects few wetlands directly, it has begun to occur on agricultural land in southern Ontario and may contribute to further wetland conversion in rural areas (Snell, 1992). Urbanization leads to the need for other services, including industrial development and waste disposal sites. With the loss in wetlands, has come an increased awareness of the benefits of wetlands.

Wetlands contribute significant ecological and socio-economic benefits and have

been linked to many of the global environmental issues including water quality and quantity, soil and water conservation and wildlife habitat (Thomas, 1987). They also serve as centres of nutrient retention, storage and exchange (Cox and Witty, 1993). Thus, wetlands perform functions such as maintenance and improvement of water quality, regulation of flows to reduce flooding, augmentation of late summer stream flow and recharge of the groundwater supply. Noble and Wolfe (1984) showed that a river basin with no wetlands had a discharge rate five times that of a basin with 40 % wetland cover. An increased discharge rate accelerates erosion and deposition causing significant downstream impacts. Maltby (1991) found that 15 % wetlands by area in a river basin could reduce peak flood levels by 60 - 65%. Wetland flora, important in bank/shoreline stabilization and the dissipation of erosive forces, may also be important food sources, nesting places, material and cover for shoreline and terrestrial biota (Madramootoo et al., 1994).

Wetlands are often highly productive biological systems important to the life cycles of many species for production and staging areas of migratory birds, spawning and nursery grounds for fish, and habitat for numerous other insects, plants and animals (Cox and Witty, 1993). One-third of the wildlife species that have been identified as endangered, threatened or rare by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) live, feed or reproduce in wetlands. Some of the rarest species can only be found in wetlands. With the loss and degradation of wetlands, comes the extinction of more plant and animal species (NAWCC, 1992).

Quantifying the value of wetland functions may be difficult. Although, the number of shorebirds or waterfowl inhabiting a wetland may be counted, the economic benefits

associated through hunting or ecotourism requires a different means of measurement and evaluation. Value to society may come either as a consumptive use, such as rice harvest or non-consumptive, for water purification. Numerous other intangible functions, more difficult to evaluate include an existence value or assessment for "just being there" and an option value, the long-term value of the feature, if lost. Wetlands are estimated to provide over $10 billion in benefits to Canadians each year (NAWCC, 1990). It has also been estimated that wetlands contribute $1 billion to Ontario's economy in tourism, recreation and in hunting/trapping (Keating, 1989). However, the continued degradation of wetlands by land-use practices resulting in vegetation and habitat destruction, nutrient and toxin loading, sedimentation, turbidity and changing flows cause considerable costs. Such costs include those related to damages by flooding, decreased crop yields due to a lack of soil moisture and lost revenues from hunting and fishing. Costs also relate to replacing functions of lost wetlands, such as purification treatment systems or to create new wetlands to support wildlife. It is estimated $80 million/year will be spent on wetland conservation by public/private sectors from 1990-2005 (NAWCC, 1990). Yet these are important values which should be taken into account when making decisions involving wetlands especially in areas where any further loss and degradation cannot be suffered without serious economic and environmental results (NAWCC, 1992).

2.2 Evolution of Wetland Protection Policies

In 1971, wetlands began to receive international recognition as complex productive and valuable ecosystems which were seriously under threat throughout the world (Dugan, 1990). Representatives of eighteen countries and several interest groups concerned about the

extent of wetland losses met to draft the Convention on Wetlands of International Importance Especially of Wildfowl Habitat. The major objective of the convention was "to stem the progressive encroachment on and loss of wetlands, now and in the future" (Gillespie et al., 1991). The convention, known as the Ramsar Convention, came into effect on December 21, 1975. In January, 1981, Canada became a signatory to the convention and with cooperation from the Provinces and Territories, Canada accepted the responsibility for identifying and describing sites worthy for inclusion in the list and ensuring that they would receive adequate legislative protection. Between 1981-1988, Canada, had designated 30 wetlands covering 12.9 million ha, the largest area proclaimed by any signatory (Gillespie et al., 1991).

Although Canada's international involvement began only within the last two decades, concern for wetland protection dates to the early 1900s. In 1916, following the signing of the Migratory Birds Convention, a treaty between the United States and Great Britain on behalf of Canada, the Canadian Parliament passed the *Migratory Birds Convention Act* in 1917 to protect migratory birds and their eggs and nests. In 1920, the first migratory bird sanctuaries were established under the act to protect critical habitat. The Canadian Wildlife Service now protects 100 sanctuaries covering 11.3 million ha or 1.1 % of the area of Canada, many containing significant wetlands. Such sanctuaries are held in trust by federal and provincial governments or owned by private landowners.

In the 1960s, the loss of wetlands in southern Canada was occurring at an ever increasing rate; however, the Migratory Bird Sanctuary Regulations, intended to protect birds, did not specifically include protection of wetlands and other habitats. The *Canada*

Wildlife Act was enacted in 1973 to allow the federal government to acquire key areas through acquisition, donation or lease for conservation, research or education purposes. National Wildlife Areas were established under this legislation and now include 45 areas covering 290, 000 ha. The *Canada Wildlife Act* encouraged cooperation between the federal, provincial and territorial governments in programs to protect wetlands.

In 1975, the Province of Ontario began to recognize the benefits of wetlands and to protect the remaining wetlands. Mr. Leo Bernier, the Minister of Natural Resources at the time, wrote: "My Ministry accepts the challenge of protecting wetlands and marshes " (Reid, 1981). Plans were outlined to incorporate wetland policies into official plans and various pieces of legislation.

By 1979, OMNR released a proposed Interim Wetlands Conservation Policy. The draft policy outlined the Ministry's responsibilities in recognition of the values of Ontario's wetlands. The Ministry was to ensure that the values of wetlands were given due recognition in all federal, provincial, municipal and private planning or development proposals. In southern Ontario, south of Precambrian Shield, the Ministry was to make every effort to maintain, enhance and increase wetlands. Any further destruction or degradation of wetlands was to be strongly opposed. Other agencies were encouraged to support the protection and wise use of Ontario's wetlands by participating in the provincial-municipal planning, resource management system and by developing specific programs (Reid, 1981). This remained a government document and was never released to the public.

After much prompting by special interest groups such as the FON, an interministerial committee known as the Mansell Committee was formed by the government in 1980 to

begin discussions for development of a wetlands policy. The Province, by designating this committee, for the first time and for the purpose of policy planning, addressed the wetlands issue in a comprehensive manner (Halen, 1988). A report released in 1981, by the Policy Committee, confirmed the proportion of wetland loss and made recommendations on how to repair the negative impacts. Recommendations included the need for accurate information on the size and significance of wetlands, requirement of a provincial policy to provide direction, changes to provincial statutes, delegation of responsibility, public awareness programs and provisions of incentives. This report was also not publicly released (Reid, 1981; Parsons and Patterson, 1984).

In September, 1981, the committee released *Towards a Wetlands Policy for Ontario*, a discussion paper to solicit public input. This paper was considered by OMNR to be an example of policy development, considered "the most important component of the planning process, defining the terms of reference for all activities by the Ministry" (Houser, 1981). A total of 520 letters and briefs were received in response from the public, special interest groups, agricultural groups and others. Almost every response, except for one, requested the protection of wetlands. Wetland loss through farmland drainage acceptable under the *Ontario Drainage Act* was a major concern. The issue most often raised was the need for wetlands to receive careful consideration in land use decisions (OMNR, 1983).

The release of the discussion paper was, in part, the impetus for the Ontario Wetlands Conference hosted by the Federation of Ontario Naturalists and the Department of Geography at the Ryerson Polytechnical Institute, held in Toronto from September 18-19, 1981. The purpose of the conference was to bring together stakeholders, especially key

participants in Ontario's wetlands planning, to discuss issues affecting wetlands and to push to have wetlands on the political agenda (Parsons and Patterson, 1984). Critical issues affecting wetlands included: political and public indifference to wetland values, the existing tax system penalized landowners from preserving natural features and outdated economic incentives supported wetland loss. Although economy was an important theme, legal change was considered imperative to adequately protect wetlands (Champagne, 1981). However, the conference failed to motivate the provincial government to produce a wetlands policy (Patterson, 1989).

The government in 1984 released the *Guidelines for Wetlands Management*. This paper marked the beginning of the Wetlands Provincial Policy Statement issued under Section 3 of the *Planning Act* (Chisholm, 1994). After public input, the purpose of the guidelines was "to provide local municipalities with direction regarding the Province's interest in the identification and protection of significant wetlands through the land-use planning process" (Halen, 1987). Land use planning identified where the Ministries planned to achieve the objectives established through policy development (Houser, 1981). While legislation changes were being drafted, a wetlands evaluation system was being designed.

Before planning or management policies could be implemented for wetlands in a large geographical area, an inventory assessing the relative values of the wetlands was required (Glooschenko et al., 1986). In Ontario, an evaluation system developed by the Wildlife Branch, OMNR and the Canadian Wildlife Service, Environment Canada for southern Ontario evolved through a process of consultation and field testing. Testing was needed to reduce subjectivity and increase clarity, as statistical analysis had revealed high

observer variability in scoring of the wetlands (Collins et al., 1984). By early 1984, the system was being used to evaluate many of Ontario's wetlands. The system used relative values and functions by translating the features of a wetland into quantified values, according to four specific components: Biological, Hydrological, Social and Special Feature Components. Through the evaluation system, points are given to each of these components to a maximum of 250 points. Wetlands are considered to be provincially significant if (a) the total wetland score is 600 points or more, or if (b) either the biological or special features components score 200 points or more. Based on the total score, the wetland is ranked from Class 1 to Class 7. Class 1, 2 and 3 are considered Provincially significant wetlands. The Province recognized that although many wetlands do not score high enough to be considered provincially significant, these wetlands still provide important benefits. Further explanation of the evaluation system procedure is provided in The *Ontario Wetland Evaluation System for Wetlands of Ontario South of the Precambrian Shield* (OMNR, 1984). The third edition was released in March, 1993, after revisions were made based on new scientific information and the 8 years of experience in wetland evaluation with the previous manual (OMNR, 1993b).

Between 1983 and 1985, the OMNR, Canadian Wildlife Service and several conservation authorities evaluated the wetlands of southern Ontario. Of 1,140 evaluated wetlands, 152 were identified as being provincially or regionally significant (Glooschenko et al., 1986; OMNR and WWF, 1987). Results of these evaluations identified significant wetlands for municipalities and other planning agencies, non-government organizations and landowners to assist in wetlands protection and conservation (Van Patter and Hilts,1985;

OMNR, 1987). By 1992, about 45 % of the 2,400 evaluated wetlands in southern Ontario (and 80 % of evaluated wetland area) were evaluated as being provincially significant (NAWCC, 1992). As policy protection was growing in Ontario, ongoing federal initiatives required the need for cooperative efforts between all levels of provincial government.

In 1986, the North American Waterfowl Management Plan was jointly signed, by the Canadian and United States governments. The Plan outlined a broad policy framework and objectives for the preservation, maintenance, and restoration of waterfowl habitat including wetlands important to the survival of migratory waterfowl of both nations (NAWCC, 1991). Federal initiatives and policies compelled the Province to continue to build awareness on the issues of wetlands and to develop a provincial wetland protection policy.

In 1988, *Wetlands: inertia or momentum?*, the second wetlands conference was hosted by the FON and Ryerson Polytechnical Institute. The conference was held as it was considered an "opportune time to assess the progress over the last few years, consider future directions and continue to press the government for the release of a provincial wetlands policy" (Bardecki and Patterson, 1988). More than 300 delegates attended the two-day conference with keynote speakers reviewing policy and management issues. The keynote presentation, by The Minister of Natural Resources, Mr. Vince Kerrio, gave attendees a sense of wellbeing, as a draft wetlands policy was being circulated for comment (Patterson, 1989).

Following the conference, a draft of the OWPS and Implementation Guidelines were released. Although the FON and other groups were pleased that a draft wetlands policy was available, there were numerous concerns. The draft wetlands policy failed to include Class

3 wetlands as provincially significant and the protection of the Class 3 - 7 wetlands were to remain with municipalities as they 'deemed appropriate.' As well, the evaluation results formed the basis to justify land use compatibility with wetland conservation. This was considered to place undue significance on the evaluation results which might promote misuse of the system and impact the integrity of the evaluation system (FON, 1988). There was also no changes to the degradation of wetlands caused by agricultural land drainage promoted by the OMAFRA (Patterson, 1989) through the *Ontario Drainage Act* and the *Tile Drainage Act*. Planning policies to guide protection of wetlands from the ongoing impacts, directly due to development, as little scientific data was available, since non-point source pollution can come from so many different activities.

2.3 Policy Control of Non-Point Source Pollution in Ontario

Federal involvement in the control of non-point source pollution is limited. This situation exists for jurisdictional reasons, since land-use planning is a provincial responsibility and the difficulty of determining the origin of non-point source pollution (Snell, 1987). Effective control of non-point source pollution falls to provincial practices and policies. Several acts may assist in regulating non-point source pollution. Storm water run-off and extractive operations are regulated by the *Ontario Water Resources Act*, the *Municipal Act* and the *Planning Act*. Pits and quarries are also regulated by the *Pits and Quarries Control Act*. The *Pesticides Act* established licencing for large and small scale applicators. Liquid and solid waste disposal areas are regulated by permit under the *Environmental Protection Act*. There is also legislation to prevent erosion through the *Woodlands Improvement Act* and the *Conservation Authorities Act*. Since non-point source

pollution results from so many activities, it is difficult to assess completely in the terms of this study, if all of these acts support protection of wetlands from non-point source pollution. Since the *Planning Act* directly affects planning and policy making at the local municipal level, the wetland policies within local official plans will be assessed.

Municipalities can only exercise the specific powers given to them by provincial legislation, specifically under the *Planning Act*, the *Municipal Act* and those acts guiding regional municipalities. The *Planning Act* provides for restrictions on private property rights through the implementation of official plans, zoning by-laws, site plan control areas and subdivision agreements. The act also provides for the inclusion of provincial policies by municipalities and the Ontario Municipal Board with respect to the development of lands. Section 3 allows for the issuance of "policy statements that have been approved by the Lieutenant-Governor-in-Council on matters relating to provincial planning that in the opinion of the Minister are of provincial interest" (OMMAH, 1992). These policies become amendments to the *Planning Act*, to act as guidelines for municipal planners to follow, but since the guidelines are not legislated as law, such guidelines are not enforceable. The Wetlands Policy Statement (OWPS) addressed wetlands from a land-use perspective as prescribed under the *Planning Act* (OMNR and OMMA, 1992).

2.4 The Wetlands Policy Statement prior to Bill 163

The Province of Ontario's Wetlands Policy Statement (OWPS) was first issued under the *Planning Act* by the Ministry of Natural Resources (OMNR) and the Ministry of Municipal Affairs (OMMA) in June, 1992. The OWPS was the fourth Policy Statement to be issued under section 3 of the *Planning Act*. The others included the Mineral Aggregate

Resource Planning Policy Statement, the Flood Plain Policy Statement and the Land-Use Planning for Housing Policy Statement. Also issued under the Act was the Food Land Guidelines and the Growth and Settlement Policy Guidelines. Section 3(1) of the *Planning Act* states that:

> *The Minister [of Municipal Affairs], or the Minister together with any other Minister of the Crown, may from time to time issue policy statements that have been approved by the Lieutenant Governor in Council on matters relating to municipal planning that in the opinion of the Minister are of provincial interest.*

All policy statements represented issues which were considered of Provincial Significance by the Minister. As such, the wetlands of Ontario became an issue of provincial interest. The policy required all municipalities, planning boards and the Crown to "have regard to" protection of provincially significant wetlands in land-use planning providing municipalities and planning boards with a framework for using their Official Plans as a means of comprehensively planning for wetlands.

The goals of the OWPS was to ensure that all wetlands were identified and protected through the land-use planning process and that there was no loss of "provincially significant wetlands". Policy 1.2 stated that where Provincially Significant Wetlands have been identified, all planning jurisdictions, including municipalities and planning boards, shall incorporate policies and protect Provincially Significant Wetlands in official plans, zoning by-laws and other development decisions under the *Planning Act*. Section 3(5) stated that the council of every municipality, local board, minister of the Crown and ministry, board, commission or agency of the government including the Municipal Board "shall have regard" to policy statements on planning issues. The OMNR was responsible for identifying all

provincially significant wetlands, while Councils, planners, approval and regulating authorities were given the responsibility to proactively protect wetlands by showing the wetlands in schedules and incorporating policies in all relevant planning documents such as official plans. According to the Implementation Guidelines (1989), "have regard to" did not imply casual attention to, nor did it require mandatory compliance. The phrase was meant to have municipalities give serious consideration to the intent of the Policy Statement and how it would be reflected in planning documents and associated development control decisions (OMNR, 1989).

Under the *Planning Act*, municipalities and planning boards are required to review their planning documents every five years to determine whether or not provisions are up to date and to reflect local circumstances. Due to the increasing public support for wetland conservation, the Implementation Guidelines (1989) advised municipalities and planning boards to review their current official plans and practices as they related to wetlands management. For those which already had comprehensive wetlands planning policies in their official plans, there was no need to update those policies, as long as the intent of the Policy Statement was met.

Policy 1.3 encouraged all planning jurisdictions including municipalities to protect other wetlands (ie. Class 4-7) that were not considered provincially significant. Given that some municipalities have small areas of wetlands and that all wetlands have some environmental significance, these other wetlands were considered to have regional or local significance. The policy approach for protection of these wetlands would be a local decision by the appropriate planning body (OMNR and OMMA, 1992). The OMNR was responsible

for identifying and evaluating wetlands and would be available, with the local conservation authority to assist municipalities with their wetlands protection program.

Since the Great Lakes-St. Lawrence Region had experienced the largest loss of wetlands due to competing land uses, the OWPS did not permit any development including:

(a) the construction, erection or placing of a building or structure;
(b) site grading, excavation, removal of top soil or peat and the placing or dumping of fill;
(c) drainage works, except for the maintenance of existing municipal and agricultural drains.

This provision supported the goal to achieve no loss of provincially significant wetlands including no loss of wetland area or functions as they existed or naturally evolve. The policy clarified, however, that this did not include the concept of no net loss or the artificial replacement of wetlands. As well, 'no development' did not mean the Province or municipality was required to acquire the land.

Further, development would only be permitted on 'adjacent lands' provided the proponent could prove, through an Environment Impact Study (EIS), the development would not result in any of the following:

(a) loss of wetland functions;
(b) demand for future development which will negatively impact on existing wetland functions;
(c) conflict with existing site-specific wetland management practices; and,
(d) loss of contiguous wetland area.

Adjacent lands as defined in the OWPS are those lands within 120 metres of an individual wetland area; and all lands connecting individual wetland areas within a wetland complex. It is noted that adjacent land is an area within which no development may occur

to impair wetland functions. Although, it is not a buffer zone, buffers are recognized in the OWPS as being the most efficient way to protect wetland functions. Constraints on development within adjacent lands, can include an area quite distant from the boundary of a wetland area within a wetland complex and can vary considerably depending upon the potential impacts. The cumulative effects of development on adjacent lands in both quantity and over time must be considered (Government of Ontario, 1997). In order to incorporate the policies of the provincial statements, the Province began to recognize the need to review the *Planning Act*.

2.5 Comprehensive Set of Policy Statements after Bill 163

Acknowledging that a thorough evaluation of the planning process was required, the Ontario government, in 1991, appointed the Commission on the Future of Planning in Ontario to review and recommend land-use planning changes to the *Planning Act*. The commission inquired into the development of a planning process that was "more fair, open and accountable" and would "recognize and support environmental, agricultural and other public interests" (Neysmith, 1992). The Comprehensive Set of Provincial Policy Statements (CSPS) was released by the Minister of Municipal Affairs on May 18, 1994 and came into effect on March 28, 1995. A number of amendments were made to the *Planning Act*, the *Municipal Act, Lakes and River Improvement Act* and the *Environmental Protection Act*. Habitat protection became focused on a landscape approach to core natural areas, buffers , corridors and wetlands. Bill 163 legislated for no development in these critical natural areas and for environmental impact statements in adjacent natural areas. For environmentalists, the reforms took a direction towards strengthening municipal power,

while diminishing provincial power (Taylor, 1994). However, there was a concern for the protection of large scale natural systems based on site-by-site development and fragmented planning system and without any corresponding shift in resources (Taylor, 1994).

The bill provided the delegation of responsibilities to local municipalities in exchange for greater consistency of local plans with provincial policy. Amendments included the requirement that all government ministries and agencies "be consistent with" the new policy statements. Municipalities would need to review their official plans every five years, however official plans developed under the new system were considered consistent with provincial policies, even if they were not. The province's power to declare provincial interest, as described prior to Bill 163, was removed and the Ontario Municipal Board, considered to be the highest level of arbitration (Taylor, 1994). The reforms were moving from a system that could appeal to a higher authority with a broader and less parochial perspective to a system that was to be locally dominated. Taylor (1994) consistently opposed such delegation since municipalities were not considered to have and could not be expected to have, the provincial perspective. Although this trend of handing responsibility to the local planning body was viewed as a positive step, a lack of funding to empower local municipalities to enhance planning could temper the outcome (Koonce et al., 1996).

Goal 2 of the Natural Heritage, Environmental Protection and Hazard Policies of the CSPS, was to ensure that wetlands were identified and adequately protected through the land-use planning process and to achieve no loss of provincially significant wetlands. As with the OWPS, all planning jurisdictions including municipalities, planning boards and

resource management bodies were required to protect provincially significant wetlands, where they had been identified and encouraged to protect other wetlands. In the absence of a provincial body to coordinate, monitor and enforce guidelines, there was concern that the Natural Heritage and Environmental Protection policy statement could not be supported, if authority to protect these features on private land was passed from the province, which had the technical expertise and could view the province and the linked natural features as a whole, to municipalities where there was a pressure to develop and often with few resources and minimal staff (Taylor, 1994).

In the Great Lakes-St. Lawrence Region, development and adjacent lands were similarly defined in the OWPS. Lands being used for agricultural purposes, whether or not they were wetlands at one time, were considered to have been converted to alternate uses and if on adjacent lands, established agricultural activities permitted without an environmental impact study.The 'no development' relied heavily on environmental impact studies to be judged locally often by unqualified staff and councils (Taylor, 1994). Without provincial standards, significance was considered to be largely a matter of local judgement and mapping erratic or nonexistent with less protection (FON, 1990).

After implementation of Bill 163, the Minister, the Council of a municipality, a local board, or planning board and the Municipal Board, in carrying out their responsibilities under this Act, "shall have regard to", among other matters, matters of provincial interest such as the protection of ecological systems, including natural areas, features and functions and the conservation of features with significant scientific interest. A decision of the council of a municipality, local board, planning board, the Minister and Municipal Board under this

Act and such decisions under any other Act as may be prescribed "shall be consistent with" policy statements issued under subsection (1). However, a newly elected provincial government began to develop another policy statement. On May 22, 1996, the Province issued a Policy Statement under Section 3 of the *Planning Act*, after Bill 20 replaced the CSPS.

2.6 Provincial Policy Statement after Bill 20

After enactment of Bill 20, Section 3 of the *Planning Act* requires that, in exercising any authority that affects planning matters, planning authorities "shall have regard to" policy statements issued under this Act. All applications received from 1995, were now subject to the Provincial Policy Statement (PPS). The PPS encourages planning authorities to further the "minimum standards established in specific policies, in developing official plan policies and when making decisions on planning matters, unless doing so would conflict with any other policy." Due to the integration of the policies, all of the policies pertinent to the planning matter must be applied. Official plans must integrate all applicable provincial policies and apply appropriate land use designations and policies. As the policies are meant to focus on end results, the official plan was considered to be "the most important vehicle for the implementation of the Policy Statement" (Government of Ontario, 1997).

Interestingly, the Province, in consultation with municipalities is seeking to identify performance indicators for measuring the effectiveness of some or all of the policies and to monitor their implementation. Municipalities are encouraged to establish performance indicators through the implementation of the policies in their official plans. The policy suggests municipalities should identify specific maintenance/improvement targets as well

as planning requirements or options for achieving them. It is unclear in the Natural Heritage Training Manual (1997), the specifics of the performance indicators or the basis upon which the indicators would be developed, at any level of government.

The policy incorporates protection of a variety of natural areas, features and functions. Policy 2.3 Natural Heritage recognizes seven components that should be considered: significant wetlands, fish habitat; significant woodlands and valley lands south and east of the Canadian Shield; significant portions of the habitat of endangered and threatened species; significant wildlife habitat; and significant areas of natural and scientific interest. Collectively, the individual natural heritage features and areas within a given planning area form a natural heritage system. The intention of the PPS is to identify these areas and features, based on their significance and protect them from incompatible development.

The Natural Heritage Policy established two categories of natural heritage features and areas and their corresponding adjacent lands. Category 1 Features and Areas (Policy 2.3.1. a) include only significant wetlands south and east of the Canadian Shield and significant portions of the habitat of endangered and threatened species. Development and site alteration, such as filling, grading and excavation is not permitted within these areas. Significance in the PPS, as concerning wetlands, is defined as an area identified as being provincially significant by the OMNR using established evaluation procedures. For Category 2, other Features and Areas outlined in Policy 2.3.1 b) are ecologically important in terms of features, functions, representation or amount and contributing to the quality and diversity of an identifiable geographic area or natural heritage system areas, where development and

site alteration may be permitted if it has been demonstrated that there will not be any negative impacts on the natural features or the ecological functions for which the area is identified. The Natural Heritage Training Manual (1997) states that a planning authority may, as part of the identification and evaluation of the natural heritage features and areas in their jurisdiction, decide to include other areas as Category 1 lands, especially when these areas are of significance to the local community. Wetlands of regional or local significance could be included in Category 1 lands.

Section 2.3.2 states that development and site alteration, may be permitted on adjacent lands, to those natural heritage features and areas including significant wetlands, only if it has been demonstrated that there will be no negative impacts on the natural features or on the ecological functions for which the area is identified. Adjacent lands are defined as those lands, contiguous to a specific natural heritage feature or area, where it is likely that development or site alteration would have a negative impact on the feature or area. The extent of the adjacent lands may be recommended by the Province or based on municipal approaches, which achieve the same objectives. Policy 2.3 does not limit the ability of agricultural uses within these areas to continue. The term development in the PPS, means the creation of a new lot, change in land use or the construction of buildings and structures, requiring approval under the *Planning Act*; but does not include activities that create or maintain infrastructure authorized under an environmental assessment process; or works subject to the *Drainage Act*.

The OMNR is recommending that adjacent lands be those lands within 120 metres of individual significant wetlands or in the case of wetland complexes within 120 metres of

individual wetlands comprising the complex. The recommended adjacent land width was chosen because it is known that developments within 120 metres of wetlands have a reasonable probability of affecting the ecological functions of the wetlands which they surround. This width is also an historically used setback figure for resource protection in Ontario (OMNR, 1997). Adjacent lands cause concern for planning and development as they are not to be considered "buffer zones" or "no development areas", although an environmental impact assessment may conclude that in a given situation, part or all of adjacent lands may need to buffer a natural area from development. The Province suggested planning authorities may adopt the recommended adjacent land widths or may adopt alternative widths that achieve the same objectives (OMNR, 1997). It was recognized that adjacent lands serve to protect aquatic ecosystems from the impacts of development including nutrient run-off from non-point-source pollution. Such negative impacts from nutrient run-off include algae blooms, the loss of rare plant species and a reduction in wildlife diversity (Moore et al., 1989; Wished et al., 1991). Approaches to determining the area of concern would be at the discretion of the local municipalities.

Criteria used to identify important natural areas may be recommended by the Province, but municipal approaches that achieve the same objective may also be used. At present, the Ontario Wetland Evaluation System (OMNR, 1993a, b) uses a provincial scoring criteria to identify provincially, regionally and locally significant wetlands. Most wetlands have been identified and evaluated by OMNR, but can also be identified and evaluated by other qualified individuals, provided training in the use of the province's wetland evaluation system is received and approved methods are used. OMNR will be

responsible for reviewing and approving the evaluations under the PPS.

Implementation of the Natural Heritage Policy will occur through the municipal planning process under the provisions of the *Planning Act* as municipal planning is "viewed as one of the most important decision-making processes in Ontario in terms of protecting the natural heritage, because it controls future land uses" (OMNR, 1997). By "having regard to" the policy, planning documents should protect natural areas, including wetlands, from incompatible development. Municipalities are encouraged to review and update planning documents, such as official plans, to ensure that the Natural Heritage policies are appropriately reflected in other planning controls such as the subdivision of land, minor variances and site plan control. At minimum, the Province seeks to have official plans recognize the importance of natural heritage systems through a municipal goal statement addressing the overall intent of the policy. The plans should also identify the location of natural features and areas through a map either integrating all components or separately. To determine the appropriateness of a development proposal, an important component of the PPS is the requirement for a site level impact assessment. It is up to the proponent of the development to ensure that the development has no negative impacts on the natural heritage system.

An IA is required for all development proposals in adjacent lands and in Category 2 areas. The minimum requirements for an IA include (a) a description of the existing natural environment that might reasonably be expected to be affected by a specific undertaking; (b) a description of the undertaking; (c) an assessment of potential effects; (d) identification of alternative methods for mitigation of potential environmental effects of the

proposed development; and (e) a monitoring plan to measure the potential effects on the environment. Due to the size and complexity of proposed developments and as municipal planning studies often cover large areas, two categories of impact assessments are noted; comprehensive IAs and site IAs.

Comprehensive IAs may be prepared as part of background studies in the development of official, secondary or special area plans or for plans for a particular natural heritage feature. Such IAs are guided by the planning authority and may be considered similar to watershed or sub-watershed studies. The comprehensive IA is a tool for planning, at a broad landscape level, to provide information to direct development in official plan schedules, designations or policies by assessing the potential impacts of various development scenarios on particular features, areas or the natural heritage system. The benefits of comprehensive IAs include providing an effective mechanism for identifying lands, where development will or will not be developed or where development may be permitted subject to a site IA. This method should reduce the level of effort required for site IAs by focusing efforts on potential impacts and directing development from highly sensitive areas through the use of official plans.

Site IAs are site-specific to a particular property. Full-site and scoped-site IAs are two types of site IAs. A full site IA is appropriate where the potential impacts of the works are unknown, complex or mitigation techniques are not readily available. Typically, full site IAs are required for large-scale developments and contain detailed assessments of the potential impacts of the development on several key functions and features. Scoped-site IAs are appropriate where proposed developments may be expected to result in minimal impacts

and where the impacts may be readily mitigated. Such scoped-site IAs may be required for small scale developments, but may used on larger scale proposals where the potential impacts of development have already been identified through a comprehensive IA and suitable mitigation techniques are readily available.

Municipalities, pursuant to the *Planning Act*, may affect non-point source pollution activities through site-level planning practices. Dodge and Kavetsky (1994) concluded that a comprehensive approach was needed to fully understand the relationship between wetlands and their degradation from non-point source pollution. A comprehensive approach through regional planning agencies was recommended to protect natural areas. In the context of the study, a watershed approach to highlight contributing areas of non-point source pollution will be used to assess the official plan policies at the municipal level to protect wetlands from non-point source pollution in the Grand River watershed.

2.7 A Watershed Approach in the Grand River Basin

A cooperative strategic approach has been ongoing in southern Ontario since the 1930s, prompted by severe water problems associated with flooding, drought and degraded water quality especially in the urbanizing areas (Veale, 1997). Problems were particularly severe in the Grand River basin, as it was recognized that rapid urbanization and massive deforestation impacted economic growth and development. Several urban communities lobbied the Province to take action. The Province responded by developing legislation enabling eight municipalities to form the Grand River Conservation Commission in 1932. The Commission was authorized to carry out studies and water conservation projects to ensure a sufficient supply of water during periods of drought and to control flood waters.

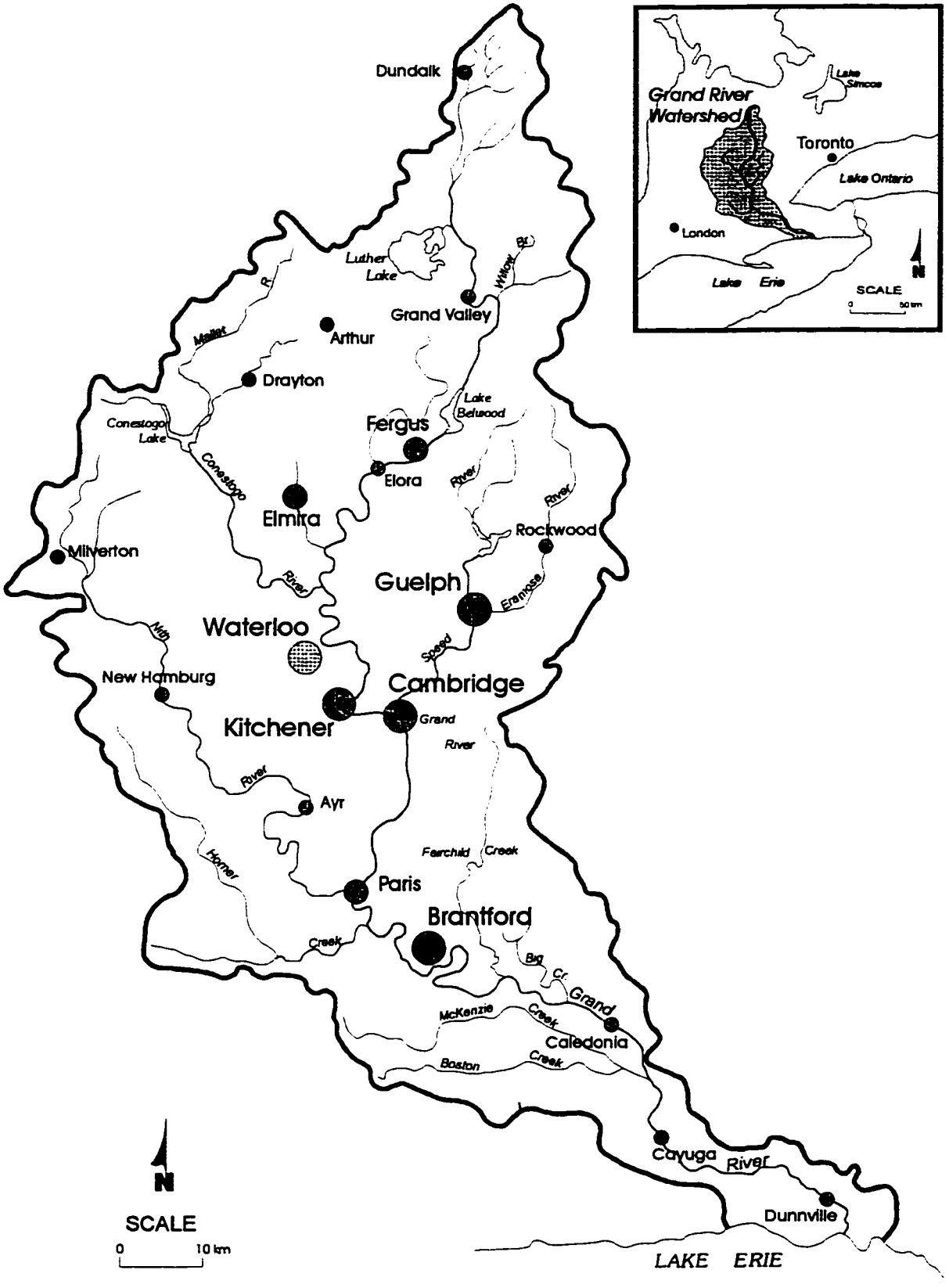
Based on this background, past and possibly present development activities are leading to the loss and degradation of the Grand River's wetlands.

Concern for water and related land resources were highlighted by the Guelph Conference held in 1941. The Conference recognized that the "depletion of renewable natural resources would place a limit on economic growth and that unplanned, individualistic exploitation of the past one hundred years should be replaced by planned management, based on knowledge and public and private participation" (Veale, 1997). The Brundtland Commission report *Our Common Future* promoted the concept of sustainable development. Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Worth noting is the fact that environmental stresses do not respect political boundaries, whether between nations, states or provinces (CELA, 1991).

In 1946, after much consideration, the *Conservation Authorities Act* was passed. The Act was based on three guiding principles: (1) the initiative for establishing and supporting a conservation authority would come from its watershed municipalities; (2) if this support was provided, the Province would be prepared to provide technical advice and financial assistance; and (3) the best unit on which to coordinate all conservation work dealing with renewable resources, including soils, was the watershed. The Grand River watershed, upon which the Grand River Conservation Authority is based, is supported by 54 municipalities including 10 regions and counties. Figure 2.0 is a map of the watershed boundary showing the Grand River, its tributaries and highlighting major cities and towns. Further details are provided in Chapter 3 and 4.

FIGURE 2.0

The Grand River Watershed



In 1994, the Grand River was designated a Canadian Heritage River by the federal and provincial governments, which acknowledged that management of its resources must be done on a watershed basis. The Province also supports watershed management on an international scale as a partner in the Great Lakes Water Quality Agreement reached between the governments of Canada and the U.S. However, the difficulty in applying the ecosystem concept to whole rivers, due to their watershed diversity, makes it necessary to reach a better understanding of large river basin ecology, particularly with respect to interactions between component systems and their variations with time and anthropogenic influences (Decamps, 1984).

Revised in 1987, the Agreement promotes an ecosystem approach to management of the Great Lakes. The Pollution from Land Use Activities Reference Group (PLUARG) demonstrated between 1976 and 1980, the effects of runoff from agriculture and urban areas on water quality and quantity to the Great Lakes. Studies indicated "the need for an integrated watershed approach to manage non-point sources of pollution in a manner to complement point source controls" (Veale, 1997). Numerous studies recognize and support an ecosystem approach to land-use planning (Royal Commission on the Future of the Toronto Waterfront, 1992), while other studies encourage municipalities to address cross municipal boundary issues on a watershed basis (Commission on Planning and Development Reform in Ontario, 1994; OMMA, 1992). The ecosystem approach seeks to integrate the linkages between the environment, economy and society.

The Sustaining Wetlands Forum held in Ottawa, April 9-11, 1990, convened by the National Round Table on the Environment and the Economy was the beginning towards

sustainable development. The purpose was to first, highlight the environmental and economic significance of wetlands and secondly, to break down the intersectoral barriers and foster the partnerships that must be formed to develop practical and effective solutions to issues affecting wetlands. Over 200 representatives of the business, agriculture, planning and environmental conservation communities from across Canada and the U.S. attended the conference. Consistently, delegates concluded that there was a need for an integrated approach to the conservation of wetlands as a component of the overall landscape. Over 70 recommendations for action were developed by and targeting the 4 sectors. The recommendations cover a range of issues, including development or modification of policies and legislation to direct planning and management, public and political awareness and education/research, monetary incentives and program tools and delivery. While recognizing wetland conservation as a globally important environmental and economic issue, the Forum concluded that sustaining wetlands would only happen from the cumulative result of individual land-use decisions (NAWCC, 1990).

The Federal Policy on Wetland Conservation, released in 1991, contained many principles that related directly to wetland protection. Its overall strategy was to ensure that wetland conservation becomes a mandate of the federal government in order to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions (Environment Canada, 1991). In addition to developing public awareness of wetland conservation, supporting technical and scientific research, one of four strategies designed to secure institutional changes, states that the government will continue to be a partner in cooperative activities with provincial and territorial governments to advance wetland

conservation (EC, 1991). The policy stressed that wetland preservation is a priority in environmental conservation and sustainable development, but recognized that conservation can only be achieved through a coordinated, cooperative approach involving all levels of government.

In Ontario, most wetland planning decisions are made at the local level, guided by provincial policy statements. Local planning for land-use by the municipalities is often the most critical arena for wetland loss or protection. From a local perspective, a certain development may seem to result only in a minor loss of habitat, however, the incremental loss of habitat can become a major regional problem (Koonce et al., 1996). Bean (1977) states that the responsibility for interpreting and enforcing these many separate and diverse laws is fragmented among many public agencies. As a result, it is difficult, if not impossible, to design and implement a comprehensive and consistent program for protection and conservation. It has been argued that the responsibility for environmental protection has been placed with environmental ministries that often have little or no control over destruction or degradation caused by agricultural, industrial or urban development policies and practices, as these are regulated at the local level of government (CELA, 1991). Legislation to preserve important wetlands have been constrained by several issues regarding land use change. Fragmented jurisdiction, which permits responsibility for wetlands among federal, provincial and municipal agencies has made protection difficult. Increased demands for land will increase land use conflicts. Continued cooperative action by local provincial and federal governments, as well as private individuals, is required to develop a strategy which protects wetlands of value and benefit to the public and resolve conflicting demands

for their conversion. The approach implies the need to anticipate and prevent environmental problems by strengthening planning procedures through incorporation of ecological components of policy along with other components (CELA, 1991). Although, decision-makers will continue to have to make choices affecting wetland retention, conversion to some other use or a combination with mitigation measures, better information and evaluation will assist in that endeavour (NAWCC, 1992).

2.8 Summary

Since settlement, much of southern Ontario's wetlands have been lost and severely degraded due to land-use changes. Land-use changes include drainage for agricultural purposes, urban and industrial growth, and recreational development. For three decades, the federal and provincial governments have recognized and implemented wetland protection initiatives. An evolution of policy statements on wetlands and natural heritage features assist the provincial and municipal governments in guiding land-use planning in an environmentally sustainable manner. Although, these policies are in place, degradation of these natural features is ongoing. Chapter 3 outlines the methods taken to identify the location of the wetlands and the areas contributing non-point source pollution in the Grand River watershed and assessment of the policies directing land-use planning within the watershed's municipalities.

CHAPTER 3: METHODS

3.0 Introduction

The lack of a practical methodology has limited attempts to identify, protect and enhance, in a comprehensive manner, the remaining wetlands which provide so many benefits to society. While knowledge has been obtained regarding their characteristics, the functions they serve, their distribution and various associated problems, there is no specific method to determine the value of wetlands relative to site-specific planning decision-making which might impact these areas.

Local councils, planners and landowners continue to make development decisions on a site-by-site basis that may impact wetlands directly or indirectly through degradation of adjacent lands. Although the decision-makers may not have good analytical tools to do so, they continue to make such decisions. Thus, it is important to develop a method to aid them in the decision-making process. The method must be: (a) practical; (b) logical; (c) understandable to the decision-maker; and (d) reflect the value of the wetlands.

A functional analysis is proposed to assess the policies guiding the site- specific development applications adjacent to wetlands in the municipalities of the Grand River watershed to reduce the risk of degradation of the wetlands from non-point source pollution. It will be necessary to develop a method, test the method on a specific watershed by involving all of the municipalities, analyze the method and ultimately, to formulate several broad statements to suggest to the Province and local land-use planners and decision-makers for appropriate development adjacent to wetlands.

Firstly, it must be determined if any wetlands exist within the municipalities. To do

this, requires the location, identification and measurement of the provincially evaluated wetlands for each municipality. Secondly, the extent of adjacent areas contributing surface water contamination must be identified to establish the risk due to degradation from non-point source pollution. To determine the pressures of development, data on the changes in population and dwelling density will be collected over a specified time period. A survey of municipal planning staff and an assessment of the wetland, natural areas or hazard land policies in the municipal official plans as they relate to the provincial policies on wetlands to highlight the strengths and weaknesses of municipalities to implement municipal policies on wetlands. Based on the results of this method, generalizations may be made on protection or rehabilitation of wetlands at risk from non-point source pollution.

Site-level planning is conducted by several levels of government. Land-use planning, a responsibility of municipal governments, is carried out by upper- and lower-tier municipal governments in Ontario. As such, quantitative information on the wetlands, contributing areas of non-point source pollution and development pressures will be included for regions and counties at the upper-tier level and for the lower-tier level, cities, towns/townships and villages. Data will also be collected for each individual municipality, since site-specific planning also occurs at this level within the Grand River watershed.

3.1 Study Area

One of the largest river systems in southern Ontario, the Grand River has a total area of 6, 980 square kilometres and is 298 kilometres in length (GRCA, 1997) stretching from the headwaters near Dundalk to the mouth at Port Maitland. Draining into Lake Erie, the system consists of the main Grand River and four major tributaries; the Speed, Eramosa,

Nith and Conestogo Rivers. The watershed has a total population of 693, 000 in 54 municipalities and 10 regions and counties (GRCA, 1997). A list of the municipalities, as referred throughout the research, is found in Appendix A. The study area was chosen due to its proximity, the number of provincially evaluated wetlands, availability of information on the impacts of non-point source pollution on the wetlands in the watershed and the researcher's experience with watershed planning in the area. Once mainly rural, portions of the watershed are undergoing intense development pressures. For the purposes of the study, the Six Nations Reserve (formerly known as Tuscarora) and a small portion of Osprey was included, whenever information was available.

3.2 Distribution of Wetlands and Non-Point Source Contributing Areas

The objective was to use a geographic information system (GIS) as a tool to map the provincially evaluated wetlands and contributing areas of non-point source pollution in the context of the Grand River watershed The map would facilitate dissemination of the information to the municipalities, conservation authority, ministries and other stakeholders to enhance research, planning and management of wetlands. Details of the GIS will be outlined in section 3.7.

Mapping of the wetlands and the delivery capability of the watershed produced during the first phase of the inventory was used as the basis for the study. The scale was 1:50, 000, as this corresponded to the scale of the Lake Erie Non- Point Source Overview Model (Snell, 1992) and existing data supplied by Environment Canada. Appropriate for large-scale or regional planning, this scale highlighted areas to be checked in the field for site-specific remedial measures. The maps identified the location of the wetlands, built-up

or urbanized areas, sand and gravel areas, water bodies, wetlands and unclassified land within the watershed of each wetland. Other spatial data sets vector format obtained from Environment Canada in 1996 included the roads network, census subdivisions, rivers/creeks, lakes and shorelines of the Great Lakes.

3.3 The Lake Erie Basin Non-Point Source Model

In 1992, Environment Canada and Wildlife Habitat Canada funded a project to create a 1:50, 000 database to rate the terrain capability to deliver contaminants for to the evaluated wetlands in the Lake Erie and St. Clair Basin. The Lake Erie Non-Point Source Model locates potentially serious problems of field soil erosion and sediment loading to wetlands by identifying and mapping specific problem sites to target remedial measures and focus followup field work. The model uses a soil loss calculation and delivery ratio to determine the capability of the landscape to transport sediment and associated contaminants to the wetland.

The Lake Erie Basin Non-Point Source Model was chosen by federal and provincial non-point source experts implementing the Canadian Ontario Agreement Respecting Great Lakes Water Quality, as input to their method to monitor target reductions, especially in the Lake Erie Management Plan. The model was also recommended for use by the Remedial Action Plans to reduce non-point source pollution (Draper and Bos, 1994) after having been verified in field studies by Environment Canada, conservation authorities and the OMEE (Snell, 1995).

3.3.1 Potential Soil Loss

The factors of the Universal Soil Loss Equation (USLE) are used to obtain the

potential erosion estimate (Wischmeier and Smith, 1978). Potential average annual soil loss is determined by the equation USLE, A=R*K*LS*C*P to calculate the average soil loss from sheet and rill erosion in tonnes/hectare/year. Sheet erosion occurs when rain washes a thin layer of soil from a field; rill erosion occurs when the soil is carried away in small water-eroded channels (Snell, 1992). *A Manual for Regional Targeting of Agricultural Soil Erosion and Sediment Loading to Streams* by Snell (1984) outlines the method used to determine the sediment entering watercourses. Minor changes were made to permit the method to be used for wetlands (Snell, 1992).

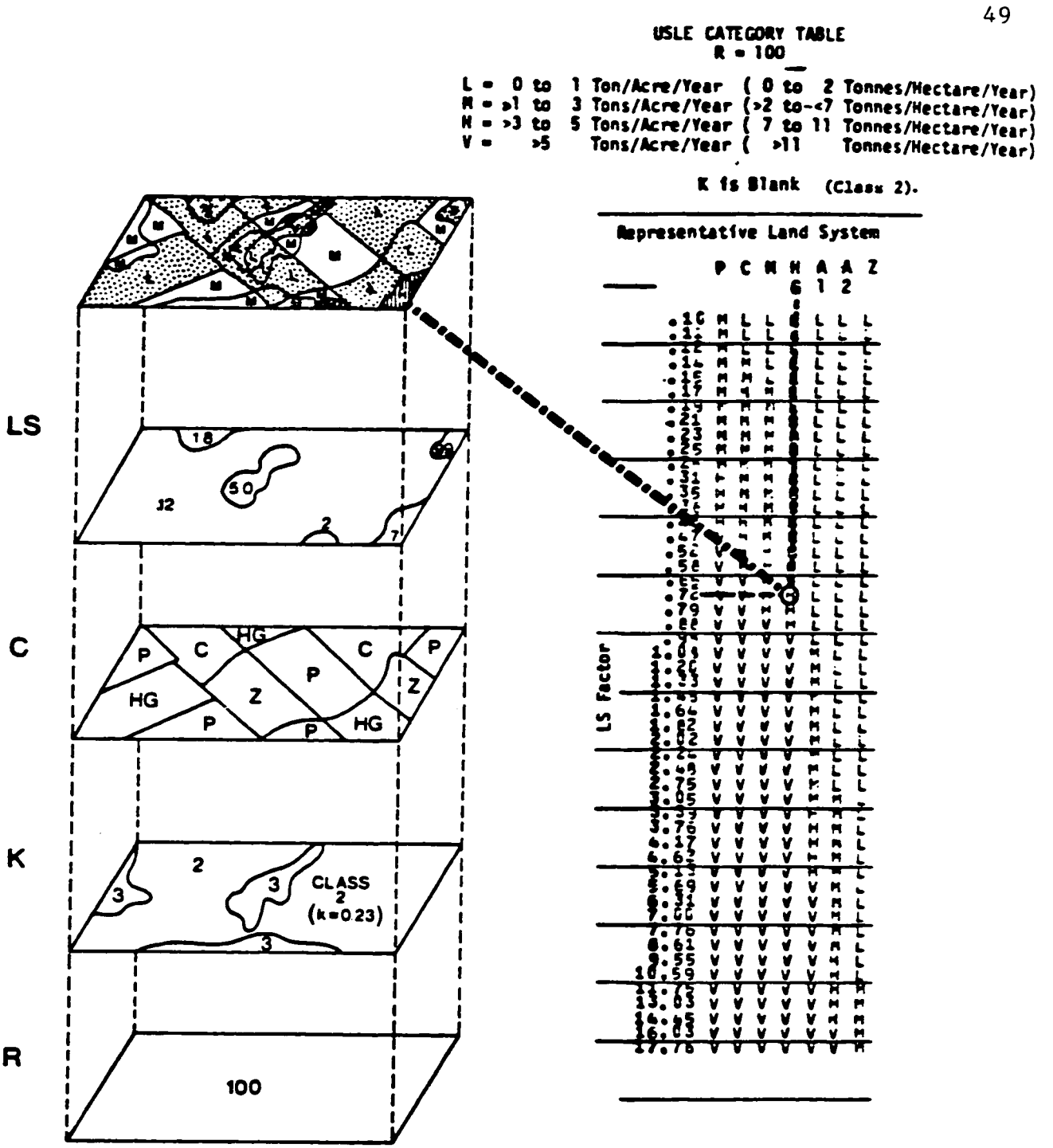
The factors of the equation represent slopes, soil erodibility, climate and land cover. An R value is the rainfall-climate factor assigned to each township from a published map for southern Ontario (Wall et al., 1983). The soil erodibility or K values were obtained from the Ontario Institute of Pedology county soils maps and published tables (Wall et al., 1981). Soil erodibility maps were based on Canada Land Inventory Agricultural Capability maps derived from the most up-to-date available county soil maps dated as follows: (a) Wellington, 1963; (b) Hamilton-Wentworth, 1965; (c) Perth, 1952; (d) Oxford, 1954; Dufferin, 1964; (e) Grey, 1951; (f) Haldimand-Norfolk, 1984; (g) Brant (preliminary), 1990; (g) Waterloo, 1971; and (h) Halton, 1970. LS or the slope gradients were determined using 10 foot contour intervals on 1:25, 000 topographic maps and spot field checked in 1991 to characterize slope lengths. The 1:25, 000 NTS maps date from 1969 to 1976, with the earlier maps in the lower Grand River from the mouth of the river to Caledonia. C factors were based on 1:50, 000 scale agricultural land system maps that categorized farm operations and rotational schedules for planting and cultivation to provide a land use factor. The land use

maps are based on 1982 data published in 1983. P is the erosion control practice factor or value given if various conservation practices are used. It is assumed for the purposes of the study that there are no remedial practices. Therefore P is given a value of 1 throughout the study area. Snell (1984) proposed this value as (a) there are few remedial practices and determination of such areas would take time with little overall effect on the mapping; (b) practices change from year to year and seasonally; and, (c) field checking can improve the value of the contributing ranking.

Multiplication of these factors by overlaying the maps represent the potential average annual soil loss or A value. Mapping outlines potential soil loss before application of remedial measures. Therefore, the map ranks an area of land for potential soil loss as if no management practices were being taken to limit soil erosion (Snell, 1985). An illustration of the overlay of maps and the soil loss calculation is shown in Figure 3.0. Although, practices could change, the maps remain accurate over several years. Map users can check potential problem areas on a regular basis and bypass those with appropriate practices to concentrate on those areas requiring further preventative actions.

3.3.2 Delivery Ratios

The delivery ratio is the proportion of available contaminants to reach a wetland. To determine delivery ratios for certain land units, Snell (1985) used ground slope data obtained from the LS factor maps, surface roughness from the C factor maps and the proximity to a wetland from the most up-to-date OMNR information obtained in 1991. County soil maps located the soils with high deposition and infiltration and identified hydrologically active areas. By using the Snell Non-Point Source Delivery Ratio Model, as shown in Table 3.0,



1. Pick USLE Category Table Page for R=100
2. Look through overlay
3. For areas of K-Factor Class 2 (K=.23), pick appropriate table
4. For each unique map unit for K-Factor Class 2, note the C and LS value
5. Read the resultant USLE Category

Figure 3.0: Illustration of Soil Loss Calculation (Snell, 1987)

Table 3.0: Legend for the Field-to-Stream or Field-to-Wetland Delivery Ratio Maps (Snell, 1987)

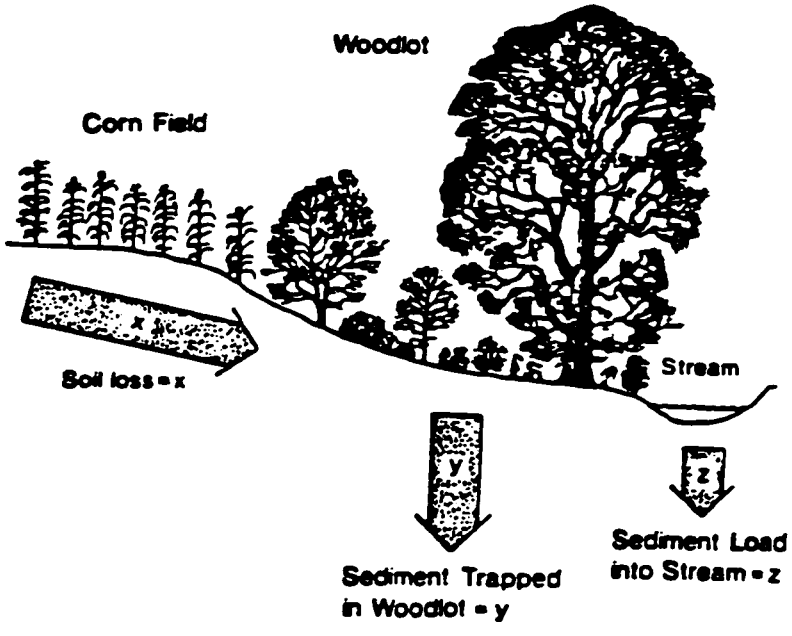
Colour Code	Label	Rank	Reason for Rank
Dark Blue	1H	High	Land close to a watercourse with no factors to reduce rank
Red	2H	High	Hydrologically active area with no factors to reduce rank
Green	3H	High	Steep slope < 100 m. Uphill of a stream or another High rank
Yellow with Black Hatching	4H	High	Flat vegetated area which is too narrow (<100 m) between a steep slope and a watercourse to be an effective buffer
Blank with Black Hatching	5H	High	A strip of land between a steep slope and a High ranking area, which is too narrow (<100 m) to substantially reduce delivery from the slope
Brown with Black Hatching	6H	High	Relatively flat, high infiltration, coarse textured soil area which is too narrow (<100 m) between a steep slope and a watercourse to be an effective buffer
Light Blue	7M	Moderate	Land without any of the above High delivery factors which is close to a potential roadside ditch that drains directly to a watercourse
Blank	8M	Moderate	Land with no conditions for either a High or a Low ranking
Brown with Black x's	9M	Moderate	Steep slope but well separated (>100 m) from another High ranking area. The intervening area reduces the slope delivery ratio to Moderate
Green with Yellow or Pink Hatching	10L	Low	Steep area with a reduced delivery ratio because it drains overland into a wide (>100 m) flat vegetated buffer zone
Yellow with Brown Hatching	11L	Low	Vegetated area which also has or is uphill of an area which has moderate infiltration, medium textured soils or organic soils and is far (>0.5 km) from a watercourse
Green with Brown Hatching	12L	Low	Steep slope which is reduced to a Low ranking because it has or is uphill of an area which has moderate infiltration, medium textured soils and is (>0.5km) from a watercourse
Orange Hatching	13L	Low	Closed depression
Brown	14L	Low	Filter area with high infiltration and coarse soils
Brown Hatching	15L	Low	Moderate infiltration, medium textured soils far (0.5 km) from watercourse or drains across such an area
Yellow	16L	Low	Relatively flat vegetated buffer area
Yellow or Pink hatching	17L	Low	Buffered area: drains overland into a vegetated area
Brown Lines	18L	Low	Buffered area; drains overland into a high infiltration area
Green with Brown Lines	19L	Low	Steep area with a reduced delivery ratio because if drains overland into a wide (>100 m) flat, high infiltration, coarse soil filter zone

these factors could be qualitatively classified to provide a field-to-wetland delivery ratio.

Sediment yield and associated contaminants are a product of soil loss and transport capability or the delivery ratio. The delivery ratio depends upon: (1) distance to a wetland; (2) slope; (3) roughness of the landscape or the amount of vegetation the runoff must flow through; (4) the capability of an area to generate runoff or hydrologic activity; and (5) hydraulic characteristics of the sediment.

Hydrologic activity is defined as the ability of water to run off a saturated soil carrying sediment away. Hydraulic characteristics refers to the fact that fine soils tend to travel farther than coarse soils, while coarse soils encourage infiltration reducing runoff and its transport of its sediment load. Figure 3.1 demonstrates the soil loss, delivery ratio and sediment load in a landscape through determination of the proportion of the soil loss reaching a watercourse or wetland subtracting the sediment load trapped by the soil or vegetation.

By overlaying a map of the soil loss and the transport capability, Snell (1982, 1992) prioritized areas of concern for sediment yield. The approach to mapping terrain capability to transport sediment to a stream or wetland is outlined in Figure 3.2. Areas with factors encouraging delivery would be ranked high and areas limiting delivery would be ranked low. Where the terrain had a high soil loss and a high delivery ratio or a combination of high-moderate, sediment yield would be high or greater than 7 tonnes/hectare/year. A low sediment rank was assigned to areas with a low soil loss and delivery ratio, as well as areas with moderate soil loss and low delivery ratio. The low sediment yield would be less than 2 tonnes/hectare/year. All other combinations were given a moderate sediment yield or



$z = x - y$, ie the load to the stream is the soil loss minus what is trapped en route.

$\frac{z}{x} = \frac{x-y}{x}$, is the proportion of the soil loss which reaches the stream, the Delivery Ratio

Eg. if 100 tons leaves the field and 25 tons reaches the stream, the delivery ratio is 25/100 or 0.25

z = Delivery Ratio x Soil loss = $\frac{z}{x} \cdot x$

Figure 3.1: Diagram of Soil Loss, Delivery Ratio and Sediment Load (Snell, 1987)

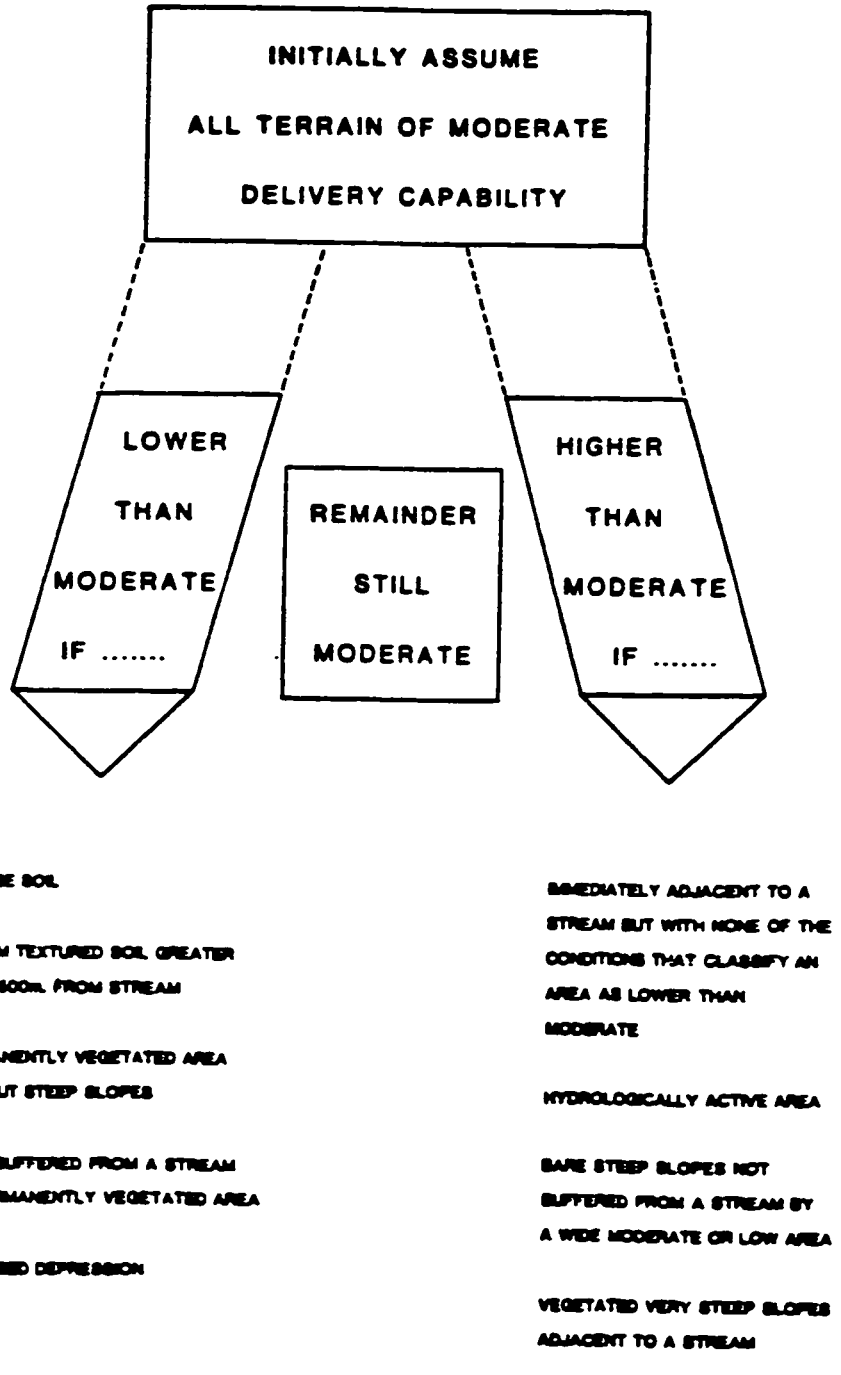


Figure 3.2: Approach to Mapping Terrain Capability to Transport Sediment to a Stream or Wetland (Snell, 1987)

between 2-7 tonnes/hectare/year. Nineteen potential erosion estimates are listed in Table 3.0 to describe the levels of information available, but for this study, the potential erosion estimate was ranked into categories of high, moderate and low potential erosion and delivery. The data was developed on a regional scale and appropriate for this study on the municipal level to locate potential problems, the scale is inappropriate for on-farm conservation planning (Snell, 1985). Non-point source pollution can be contributed to wetlands via the water to any tile drain, stream or river. However, for the purposes of the research, only those contributions overland to wetlands were mapped.

Originally designed for the field-to-stream Delivery Ratio mapping for the Lake Erie Basin Non-Point Source Overview Model, some minor adjustments were required to apply to the delivery ratio for wetlands. All contributing area slopes in the Grand River basin were reviewed from the 1:25,000 NTS maps, where available and if they were not available, slopes were noted using the 1:50,000 NTS maps. Dates of the 1:50, 000 maps are noted in Table 3.1.

Table 3.1: National Topographic Series Maps for the Grand River Watershed (1997)

NTS Map Name	Number	Date	NTS Map Name	Number	Date
1. Cambridge	40 P/8	1984	7. Conestogo	40P/10	1986
2. Guelph	40 P/9	1985	8. Stratford	40P/7	1986
3. Woodstock	40P/2	1985	9. Orangeville	40P/16	1984
4. Simcoe	40I/6	1983	10. Brantford	40P/1	1984
5. Dundalk	41A/1	1978	11. Palmerston	40 P/15	1986
6. Dunnville	30L/13	1983	12. Hamilton-Grimsby	30M/4 (West)	1984

3.4 Wetland Location

Mapping of wetlands evaluated by OMNR in the Grand River watershed was obtained from Environment Canada through Snell and Cecile Research. The map sheets are based on the National Topographic System (NTS) 1:50, 000 series. Each map was referenced on a stable mylar map by outlining and labelling the frame and by transferring several road intersections for internal reference points which enhances accuracy of the GIS. A copy of OMNR District Wetland Evaluation maps were obtained by Snell and Cecile Research from each district office in 1991 with updates as appropriate. Wetland evaluation maps were dated 1989 for Cambridge District, 1990 for Wingham District and 1991 for the remainder of the watershed. Some of the maps were at 1:100, 000, while others were at 1:50,000. For the 1:50, 000 maps, the mylar was overlaid onto each map and each wetland traced by lining up the closest reference marks. The mylar was also overlaid on the most recent colour paper 1:50, 000 NTS sheet and based on the slope, wetland symbols and forest extent some minor revisions were made. For the 1:100,000 District Wetland Evaluation maps, the referenced mylar sheet was overlaid on the most recent colour paper 1:50, 000 NTS and shifting to line up with the closest reference marks for each wetland. Using available features from the MNR maps, the wetlands were located on the NTS map, scaled to the 1:50,000 NTS maps. For the Lake Erie basin, each wetland was assigned a number from 1 to 546. Polygons of the same wetland complex received the same number. Due to the large number of wetland complexes and the number of wetlands in each complex, the number of individual wetland polygons in the Lake Erie basin study area is several times higher than 546.

3.5 Wetland Contributing Area

The contributing area represents the basin of each wetland from which runoff would flow overland directly to the wetland without first reaching a watercourse. A mylar sheet was referenced to the 1:50,000 NTS frame and road intersections as described for the wetland location mapping. The contributing area was determined using 1:25,000 NTS maps with 10 foot contour intervals which provided the best resolution of maps.

Streams shown on the 1:25,000 NTS maps were supplemented by the OMAF drainage maps. The contributing areas were interpreted from the contours and avoided areas that flowed into streams before entering the wetland. Stream sub-basin maps interpreted from the 1:25,000 NTS for the Stream basin Delivery Ratio mapping steps were used in an earlier study by Snell (1987). All contributing area boundaries were compared and corrected, if necessary. Any streams shown on the 1:50, 000 NTS were added to the 1:25,000 maps, as the former maps contained other watercourses not shown on the latter maps.

The contributing areas included a 100-120 metre wide area adjacent to the wetland boundary unless the landscape sloped away from the wetland or the area included a watercourse evident from the 1:50,000 metric NTS. This step was added since the resolution of the sub-basin maps often placed lines adjacent to the wetland boundary when it would be just as possible for the line to be 120 metres away. It was assumed generally, that wetlands are found within a depression. This distance was chosen because it is within the NTS map resolution of most areas adjacent to wetlands and corresponded to the distance proposed for adjacent lands in the Ontario Provincial Wetlands Policy Statement (Snell, 1992). Each contributing area was assigned the same number as the wetland to which it would contribute

non-point source pollution. To better understand the impacts non-point source pollution could have on the wetlands, it was important to know the significance of the area and functions to which the pollution was contributed.

3.6 Wetland Significance

For the purposes of this study, a database file ERIEBASI.DBF provided by Environment Canada, identified each wetland within the Lake Erie basin. Attributes for the ERIEBASI.DBF are listed in Appendix B. Wetlands with numbers 22-546 correspond to the twelve maps within the Grand River watershed. Information relating to these wetlands are available in a table format. The wetland number on the maps concurred with information obtained from the Ontario Ministry of Natural Resources (OMNR) Wetlands Inventory available in 1991. The database contained the wetland number, OMNR's wetland name, the number of wetlands within a complex, class, OMNR district, township, county and National Topographic Series (NTS) map number. The class number identified the level of provincial significance of each wetland. More than one attribute could be listed for the OMNR district, township, county and NTS map number, if the wetland extended over these boundaries. Due to the large number of wetland complexes and the sharing of wetland polygons, the number of individual wetland polygons in the watershed and within each municipality were much greater than the number of wetlands from the OMNR Wetlands Inventory database for the Grand River watershed.

3.7 UNIX ARC/Info Geographic Information System (GIS)

UNIX ARC/Info (ESRI, 1997), a Geographic Information System (GIS) available at the University of Waterloo was employed to graphically display the wetlands and delivery

capability of the land within the watershed. ARC/Info is a geographic information system used to automate, manipulate, analyze and display geographic data in digital form. It is characterized by its data model, the GIS functions it performs, ability to generate many types of data, utility for developing application-specific user interfaces, its own macro language (AML) and its ability to operate on many types of computers with a variety of graphics hardware (ESRI, 1995). The software allowed for input of the data through a digitizer (for wetland locations) and a keyboard (spatial data) to manipulate the data in a variety of ways. The spatial information of the wetland area, contributing area, class and number of wetland polygons were quantified through use of the GIS.

Twelve stable Mylar National Topographic Series (NTS) based maps encompassing the Grand River watershed were obtained from the Water Issues Division, Environment Canada in 1996. Funded by the Great Lakes 2000 Cleanup Fund, the Department of Geography and Environmental Studies at Wilfrid Laurier University was contracted to digitize the remaining four map sheet areas to complete the Lake Erie Basin digital database. The majority of the land represented on these four maps were within the Grand River watershed. Digital information for the other eight maps was provided by Environment Canada on disk using the SPANS GIS. However, due to a lack of point data accuracy after transferral of the SPANS digital information into ARC/Info, the eight maps were redigitized using ARC/Info.

To complete the map of the wetlands and terrain capability of the watershed, the following steps were used to incorporate the data from the Lake Erie Non-Point Source model into the GIS.

1. Check Mylar maps for accuracy and completeness.

2. Digitize wetlands and contributing areas.

3. Review, clean and edit maps.

4. Check and verify digitized data for consistency, accuracy and completeness.

5. Add attributes to the digital database.

6. Import data from other sources.

7. Edgematch the twelve NTS digital tiles.

8. Write AML for watershed map overlaying the roads, census subdivision boundaries, watercourses, lots and concession roads and shoreline of Lakes Erie, Huron and Ontario. The AML will also create a map naming all census subdivisions and a histogram of the land use types.

9. Create map based upon this information.

10. Check overlay for consistency, accuracy and completeness.
11. Final corrections and printing.

12. Analyse and print information on the distribution and area of land use type.

Digitizing of the four maps contracted by Environment Canada began on January 1, 1996 and was completed April 7, 1996. The remaining eight maps were digitized from April, 1996 to May, 1996. The four maps contracted by Environment Canada required additional time as compared to the other maps, since a separate layer was created for the wetland watershed, the delivery ratio layer and contributing area. Polygons with 19 different reasons for erosion potential were digitized for the largest number and highest concentration of wetland polygons in the Lake Erie basin. For the remaining eight maps, the delivery ratio

and contributing area layer were digitized concurrently and the 19 reasons were categorized into a high, moderate or low ranking.

3.8 Development Pressure Indicators

To forecast areas of development concern, population and dwelling data was collected from Statistics Canada for 1986, 1991 and 1994. The census subdivision areas were compared to the GIS spatial data to determine the differences or possible error between the digital information and census area information. This information was needed for the population and dwelling density or number of people/dwellings per hectare of area. The population and number of dwellings were recorded for each time period for the regional and counties and each local municipality. To determine the change over time, the population or dwelling/ha was subtracted. A positive value indicates an increase in the population or dwelling density, while a negative means a decrease. This information is in table format and the results will be further discussed in Chapter 4 and 6.

3.9 Survey Methods

Understanding the experience and attitude of municipalities to wetlands and wetland protection policies provides information on the implications for policy implementation and decision-making. Data was collected through a survey of staff from the regional, county and local municipalities within the Grand River watershed responsible for local planning. A questionnaire was sent to each upper- and lower-tier municipality due to their authority to develop Official Plans, establish zoning by-laws and approve development proposals. Questionnaires were mailed directly to the Town Clerks. The cover letter that accompanied each questionnaire requested that it be forwarded to the most appropriate planning staff

member. In addition, the letter assured respondents full confidentiality.

3.10 Questionnaire Development and Distribution

The mail-out technique was selected for the survey, due to its relatively low cost and level of anonymity compared to other methods such as in-person and telephone interviews. In addition, mail-out questionnaires are an effective method of acquiring large amounts of information from respondents at a distance. A stamped self-addressed envelope was enclosed to expedite the return of the questionnaires. Prior to its distribution, the survey was reviewed and approved by Wilfrid Laurier University's Ethics Review Committee.

The same questionnaire was sent to each municipality which consisted of 56 local municipalities and 10 regional and county municipalities. A list of each municipality is given in Appendix A. Sample cover letters and questionnaires are included in Appendix C. A reminder was faxed to those municipalities who had not responded by January 30, 1996 to encourage the municipalities to contribute to the research.

Various publications on social research were consulted to design the questionnaire, including Babbie (1990), Hessler (1992) and Dooley (1995). In order to pretest the questionnaire, draft copies were circulated to individuals within the Department of Geography and Environmental Studies, Wilfrid Laurier University and several local municipalities. Minor alterations to the questionnaire based on these comments were made prior to forwarding the survey to all of the municipalities.

The objective of the pretest was to ensure that the questions were (1) clear, concise and unambiguous; (2) appropriate and unbiased; and (3) followed a logical order. The questionnaire was designed to be answered in 20 - 30 minutes. The questionnaire contained

both open- and closed-ended questions. Many questions gave the respondents an opportunity to provide additional comments.

The purpose of the information consent form was to receive the free consent of the respondents, as required according to the Wilfrid Laurier University Senate Policy on Ethics in the Conduct of Research with Human Subjects, as adopted May 20, 1976. The form also identified the respondent and determined their familiarity with land use planning through a request of the number of years of planning experience. Questions regarding the respondents' Official Plan was useful in the collection and review of the Official Plans for the municipalities. To increase the interest to continue and complete the survey, respondents were offered an opportunity to receive a summary of the research. Many respondents requested the summary.

The survey consisted of 11 questions. The purpose of the first two questions was to determine the level of municipal government the respondent represented and to identify whether the respondent or another level of municipal government, planning consultant or other agency conducted the land-use planning for the municipality. Question 3 sought to determine the agency the municipality would seek for information regarding the protection of or planning adjacent to wetlands. The respondent was able to outline an order of contact and the strength of those agencies to protect wetlands. The next group of questions gave the respondent an opportunity to provide an opinion on the extent of wetland protection in their municipality and comment on resources which may assist the municipality. The intent of Question 8 was to ascertain the issues impacting effective wetland protection. Changes at the provincial level to the Planning Act could affect decision making at the lower municipal

level. The purpose of question 10 was to determine if these changes would affect wetland planning. The last question in the survey tried to seek a willingness for municipalities to utilize a variety of general zoning approaches.

3.11 Official Plan Review

All 56 upper and lower tier municipal offices were contacted between June, 1996 and January, 1997 to collect and review their official plans. Access to official plans was also available through the Grand River Conservation Authority or for lower tier municipal offices, copies were reviewed at regional or county municipal office libraries. To ensure that research was based on the most up-to-date official plan, a phone call was made to each municipality. Staff were asked to provide the dates of council adoption, OMMA approval and a possible review date of the official plans. Specifically retrieved from the official plans were policies on wetlands, environmentally sensitive areas, hazard lands or other natural areas.

Questions were designed to evaluate the policies of the municipalities based on the requirements of wetland protection within the OPWS, CSPS or PPS. A ranking scale from 1-5 was used to assess the adequacy of the policies for each question as it related to the specific requirement. Adequacy, for the study, could be defined as the clear intention of the official plan policy to meet the requirements of the provincial policy statements. A five was given, if the policy was considered totally adequate in meeting the requirement. Three was considered to be adequate and a value of one was given, if the policy was inadequate. Each municipality's official plan was given a total ranking by adding the values for each quesition. If the total ranking was between 21-30, all of the policies were considered to be

totally adequate; if between 11-20, the policies were considered adequate; between 1-10, inadequate and 0 if not applicable or nonexistent. The total assessments for the regions/counties and the local municipalities were mapped to provide a visual representation of the information in relation to the watershed and distribution of the wetlands. Average rankings were obtained by totalling the assessments for each category and dividing the number by the number of representative municipalities.

Review of the official plans were based on six questions. A copy of the questions are listed in Appendix D. Question 1 sought to determine the extent the municipalities incorporated the policies of either the OWPS, the CSPS or the PPS as it affected wetlands. The purpose of question 2 was to ascertain if the official plans conformed with the appropriate policies in prohibiting development with provincially significant wetlands. Question 3 tried to establish whether the plans included policies with regards to permitting development in adjacent lands. If the official plans referred to the use of an Environmental Impact Assessment or Study, Question 4 sought to demonstrate the degree the official plans included any such study. Questions 5 and 6 tried to determine if the municipalities included any other initiatives to protect wetlands and if so, whether they included the support of other implementing agencies.

3.12 Research Limitations and Assumptions

Generalizations evolved due to the overview nature of this study. Since the GIS was based on information from the Lake Erie Non-Point Source Overview Model (Snell and Cecile Environmental Research, 1992), scale limited the location of specific field level sites of soil loss or sediment pollution. The scale of 1:50 000 was appropriate for regional scale

planning, but only considered the probability of finding site-specific problems within each area.

The agricultural sources concentrated on non-point sediment and sediment associated with contaminants, but did not specify other than agriculture, urban and landfill sites. Since water quality problems originate from many different sources, the model is based only on potential sedimentation from rural sources. The results are longterm and not to be directly compared to any one season or storm event. It did not predict if remedial measures were in place to control potential problems, but assumed that no remedial measures had been applied. The basis of the Lake Erie Model did not review the issue of the transport of contaminants upon reaching a stream. The assumption was that if a contaminant reached a stream flowing into a wetland, it was a direct threat to the wetland. Non-point sediment sources and the amount of potential erosion were quantified within a range based on the scale of data used.

The wetland mapping was affected by the scale of the data available. In some districts, the district wetland maps were 1:100 000, while other district maps were 1:50 000. Based on the scale differences and the redrawing of the mapping onto the Mylar, some distortion was found to have occurred. While digitizing, the NTS maps were referred to for revision of any discrepancies. Wetland distribution was based only on information on provincially evaluated wetlands provided through the OMNR Wetlands Inventory database. It is assumed that all of the wetlands existing within the watershed have been included.

For the purposes of accuracy, an acceptable RMS error was set between 0.002 and 0.005 (ESRI, 1995). This value was maintained to ensure the quality of data. The value of

the RMS depends on the data, the scale of the base map and the information derived. The use of large scale mapping and stable mylar material enhances the preciseness of the GIS data.

CHAPTER 4: RESULTS OF WETLAND ASSESSMENT

4.0 Introduction

This chapter presents the results of the wetland assessment or the distribution of the wetlands, contributing areas from non-point source pollution and development pressure indicators in the watershed. The total wetland area, class, number of wetlands and contributing areas within each upper- and lower-tier municipality are discussed separately. The assessment also determined the extent of the total contributing areas of non-point source pollution to the wetlands, from the possible impacts due to changes in population and dwelling density. A knowledge of the status of the wetlands, the contributing area and development pressure indicators would focus examination and assessment of the policies on those municipalities with wetlands and/or areas contributing to their degradation.

4.1 Total Area of Wetlands

Figure 4.0 is a map of the Grand River watershed displaying the wetlands, the delivery capability of the land for non-point source pollution and other land-use classes found within the wetland watersheds. The map illustrates the use of the GIS for integrating data from various sources to determine the overland contribution of contaminants to provincially evaluated wetlands and to highlight the areas at risk. The spatial information found within the map was quantified for total area of wetlands, class, number of wetlands and contributing area within each municipality. Figure 4.0 is found in Appendix E. In order to develop the map, an ARC macro language program was written and is listed in Appendix F.

Figure 4.1 is a map labelled with the census subdivision names represented in the

watershed. The census subdivisions correspond with the municipal planning boundaries. Upper-tier municipalities include 4 regions and 6 counties, while 6 cities, 8 towns, 5 villages and 36 towns and townships form the lower-tier municipalities. A municipality is an area whose inhabitants are incorporated and whose powers, are exercised by a council elected by the electors of the municipality. A regional municipality is a municipality created by a special act of the Province of Ontario and is a federation of all the area municipalities within its boundaries. A county is a municipality combined of the towns, villages and townships within its boundaries. Cities and separated towns, even though geographically part of the county, do not participate in the county political system (OMMA, 1996). Figure 4.1 is also found in Appendix E.

Figure 4.2 is a histogram of the total area of the land use types as determined by the study. The total wetland area was quantified to determine the present day coverage of the remaining wetlands. The total wetland area within the Grand River watershed is 46, 534 ha within a total watershed area of 643,719 ha or 7.2 % of the watershed. Given the total wetland area of the watershed, it is possible to determine the percent area of the wetlands within each municipality. Figure 4.2 is found in Appendix E.

Appendix G is a listing of the area differences between the GIS and the census subdivision data gathered from Statistics Canada. The average difference for all the lower tier municipalities is 5.5 %, as the GIS area tended to be larger than that of the census subdivision areas. Such differences may be due to map distortion or digitizing error. The census subdivision areas from Statistics Canada were used to determine the population and dwelling densities.

To be able to determine the municipalities having experienced wetland loss, Table 4.0 lists the changes in wetland distribution from the 1800s, 1967 and 1982 by county and region for the watershed in hectares and as a percent of the total municipal area (adapted from Snell (1987)). The information was adapted for the Grand River watershed from Snell's study which mapped by county the wetland loss for southern Ontario, south of the Precambrian Shield.

The Grand River watershed lost almost 12 % of its original wetlands since the 1800s. According to Snell (1987), the watershed, as represented by the upper-tier municipalities also lost 0.2 % of the wetland coverage from 1962-1982. The total average wetland area as a percent for the regions decreased from 19.4 % to 6.1 % since settlement. Counties also experienced a decrease in wetland area from 18.0 % to 7.5%. According to estimates from Snell (1987), the Grand River watershed lost 11.6 % of its original wetland area, with 7.0 % remaining. Figure 4.3 illustrates the wetland losses in the Grand River watershed. The table demonstrates that as the watershed became cleared for agriculture and settlement, wetlands were lost throughout the watershed. Most of the wetlands were lost in Haldimand, Perth and Dufferin counties. It is apparent when Figure 4.3 and Figure 4.0 are compared, the municipalities which have experienced the largest changes in wetlands since the 1800s to 1982. This information may be useful to indicate the municipalities that have undergone or are undergoing intense agricultural activities or urban development and may require strong policies, if few wetlands remain.

Table 4.0: Wetland Conversion by Region and County for the Grand River Watershed (Adapted from Snell, 1987)

	1800's		1967		1982	
MUN	Area (ha)	%	Area (ha)	%	Area (ha)	%
Halton	14520	15.9	5390	5.7	5910	5.6
H-N	89940	30.9	25050	8.6	24140	8.3
H-W	25030	23.9	5930	5.7	5910	5.6
Water.	9220	7.0	6660	5.1	6480	4.9
TOTAL/ MEANS	138710	19.4	43030	6.3	42440	6.1
Brant	8530	7.9	4570	4.2	4520	4.2
Well.	42180	15.8	22860	8.6	22090	8.3
Oxford	21600	10.6	9820	4.8	9760	4.8
Perth	59090	27.0	9120	4.2	9080	4.1
Duff.	38590	25.9	17610	11.8	16430	11.0
Grey	92610	20.6	57830	12.9	57080	4.1
TOTAL/ MEANS	262600	18.0	121810	7.8	118960	7.5
OVERALL	401310	18.6	164840	7.2	161400	7.0

The total wetland area by hectares (ha) and as a percentage of the total municipal land area is summarized in Table 4.1. Since watershed boundaries do not match municipal boundaries, the upper-tier municipalities are represented only by those local municipalities with land draining into the Grand River. The total wetland area was calculated by adding the applicable wetland areas of the local municipalities within the specific region or county. Values for the total wetland areas within cities, villages and towns and townships were provided by adding the wetland areas for those municipality categories. Percentages were

FIGURE 4.3

Wetland Losses in the Grand River Watershed by Municipalities c. 1800 - 1982

(Adapted from Snell, 1987)

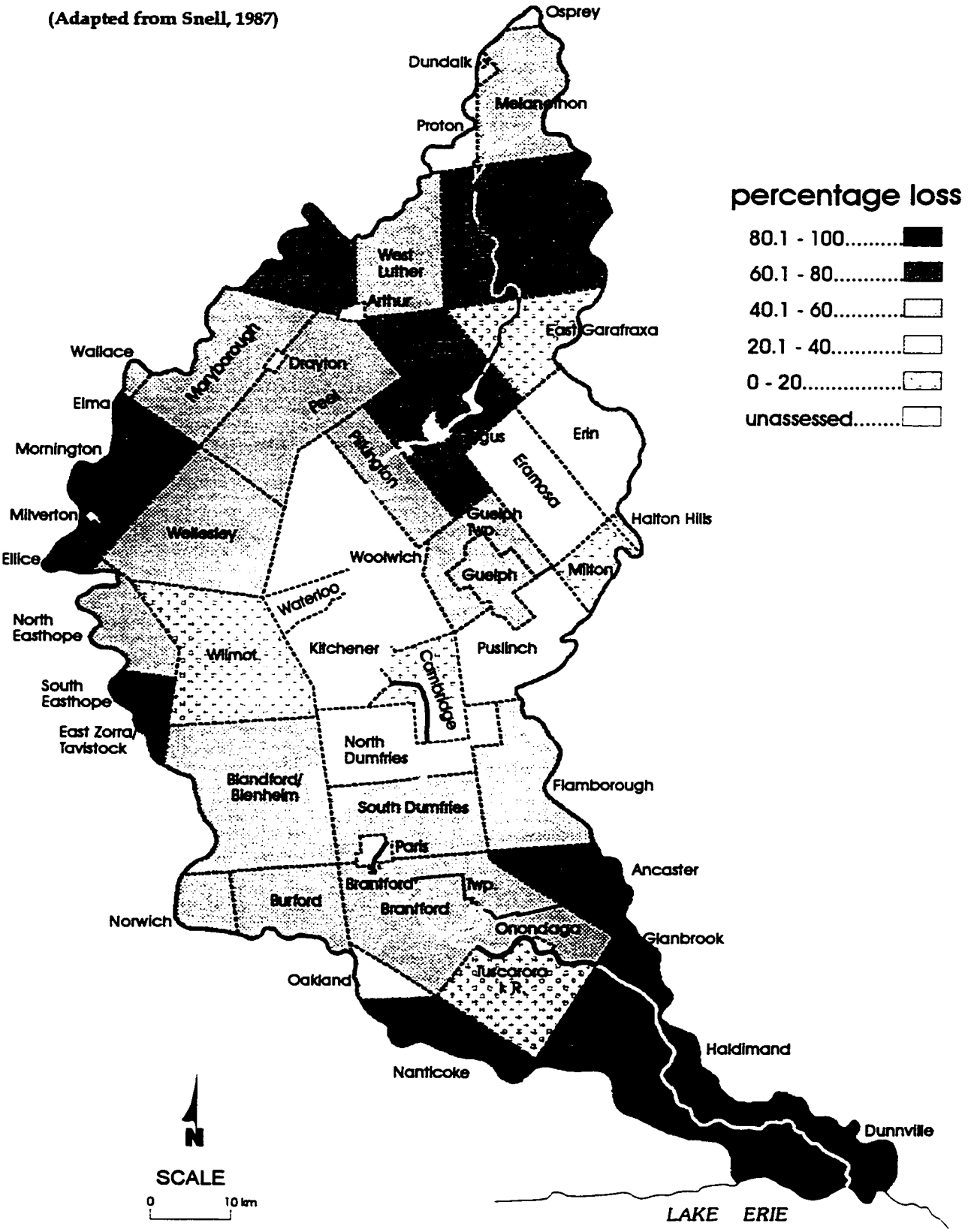


Table 4.1: Total Wetland Area within the Upper- and Lower-Tier Municipalities (1997)

MUNICIPALITY	TOTAL AREA (ha)	WETLAND AREA (ha)	PERCENTAGE (%)
Region	505 921.0	11 127.1	2.2
County	749 475.0	35 407.0	4.7
TOTAL	1 255 396.0	46 534.1	6.9
Cities	140 413.0	2 141.6	1.5
Towns/Townships	1 113 582.8	44 392.5	4.0
Villages	1 400.7	n/a	n/a
TOTAL	1 255 396.0	46 534.1	6.5

estimated by dividing the total wetland area with the total municipal land area and multiplying by 100. This information showed the difference in wetland area between the upper- and lower- tier municipalities. The total wetland area for regions and counties will be equal to that of the cities, towns/townships and villages. Regions and counties represent the upper-tier municipalities, while cities, towns/townships and villages represent the lower-tier muncipalities and depending on their location are incorporated either within a region or county jurisdiction. Measurement of the total wetland area at both levels of municipal government identifies the location and extent of the wetlands, as a land-use type to determine the possibility of focusing decision-making, at this upper-tier level of government. Official plans of the local municipalities within regions must be in conformity with the regional official plans. Until the planning reforms were legislated, cities, towns and villages within a county jurisdiction did not need to conform with the county official plan.

Counties, with their large rural land base have 4.7 % of the total wetland area within the watershed. Regions tend to be found in more urbanized parts of the watershed and have

the remainder or 2.2 % of wetlands as a land-use type. The rural land base of townships supports 4 % of the wetlands. Few wetlands are located in the developed cities and villages. The table suggests that the observed difference in total wetland area varied between the upper- and lower-tier municipalities. These differences may be explained due to past wetland loss, landscape factors or ongoing development impacts. It also suggests that policies governing their protection may vary depending on their presence as a land-use type.

Table 4.2 illustrates the total wetland area by each region and county within the watershed. The area of each region and county was determined by adding the wetland areas of each local municipality represented within each region and county. Percentages were estimated by dividing the total wetland area with the total municipal land area and multiplying by 100. Dufferin and Wellington counties have the largest area of wetlands at 8.7 % and 7.2 %, respectively. Among the regions, Waterloo contains the most wetland coverage at 4.0 %. This table suggests that the observed difference in total wetland area varies between the regions and counties. These differences may be explained due to past wetland loss, landscape factors or ongoing development impacts. Only small total wetland areas remain in Haldimand-Norfolk which experienced the most wetland loss since settlement. It also suggests that policies governing their protection may vary depending on their presence as a land-use type.

Appendix H lists the total area of wetlands and as a percent of the total area of the municipality within the watershed for the 55 lower-tier municipalities and the Six Nations lands. The five municipalities with the largest total area of wetlands are the townships of Blandford-Blenheim, Erin, Melancthon, Eramosa and Puslinch. Erin, Milton, Melancthon,

Table 4.2: Total Wetland Area within the Regions and Counties (1997)

MUNICIPALITY	TOTAL AREA (ha)	WETLAND AREA (ha)	PERCENTAGE (%)
Halton	64 705	1 322.4	2.0
Haldimand-Norfolk	232 733	2 848.5	1.2
Hamilton-Wentworth	70 086	1 353.7	1.9
Waterloo	138 395	5 602.5	4.0
TOTAL	505 919	11 127.1	2.1
Brant	110 504	4 671.9	4.2
Wellington	237 573	17 207.3	7.2
Oxford	108 571	4 638.1	4.3
Perth	138 393	221.6	0.2
Dufferin	90 813	7960.2	8.7
Grey	63 621	707.9	1.1
TOTAL	749 475	35 407	4.7

Proton and Puslinch have the largest wetland areas as a percentage of the land area drained by the Grand River, while Fergus has the smallest amount. This table indicates that measuring the total wetland area for each municipality showed that wetlands are found throughout the upper-tier municipalities, but represent a small proportion of the land-use coverage. It would be anticipated that policies within the lower-tier municipalities would be strongest for those municipalities with extensive wetland coverage.

Table 4.3 classifies the frequency of the total wetland area for the lower-tier municipalities. The most frequent class of total wetland area is between 1-500 ha. Eleven municipalities have between 501-1000 ha of wetlands, while 8 municipalities have over 2001 ha of wetlands. Therefore, the majority of municipalities have very few remaining

wetlands. This would indicate that there is a need for strong policies to protect (a) the municipalities with the largest total areas to maintain a high quality of the natural feature; and (b) those municipalities with the smallest total areas to protect the remaining wetlands.

Table 4.3: Frequency of the Total Wetland Area for Lower-Tier Municipalities

Area (ha) Class	Frequency
0	13
1-500	17
501-1000	11
1001-1500	5
1501-2000	2
2001+	8

4.2 Wetland Class

The wetland area by class in ha and as a percent of the total wetland area for upper- and lower-tier municipalities is presented in Table 4.4. The table shows that 71 % of all wetlands in the watershed are provincially significant. Of the remaining wetlands in cities, 86 % of the wetland coverage is Class 1-3 wetlands. Fifty percent of the total area of wetlands within the watershed are Class 1 evaluated wetlands and found in counties and towns/townships. The regionally and locally significant wetlands or Class 4-7 represent 26 % and 29 % of the wetlands in regions and counties, respectively. Class 5 and 6 wetlands represents the second and third largest total areas by class of wetlands or 19 % of all wetlands. The information indicates that the majority of wetlands remaining are provincially significant, perhaps that all less significant wetlands have been lost . This suggests that the official plan policies in these municipalities should recognize the provincial interest of these

areas and restrict any development, as according to the provincial policies.

Table 4.4: Total Wetland Area by Class for Upper- and Lower-Tier Municipalities (1997)

		Class						
MUN	TOTAL	1 (ha) (%)	2	3	4	5	6	7
Regions	11127.1 (24)	6189.2 (56)	1371.7 (12)	654.5 (6)	894.5 (8)	1280.0 (12)	490.9 (4)	241.6 (2)
County	35407.0 (76)	20930.2 (60)	1997.0 (6)	2185.3 (6)	1857.3 (5)	3842.9 (11)	3151.1 (9)	1412.0 (4)
TOTAL	46534.1	27229.4 (59)	3368.7 (7)	2839.8 (6)	2751.8 (6)	5122.9 (11)	3642.0 (8)	1653.6 (4)
Cities	2141.6 (5)	1331.1 (62)	218.3 (10)	292.1 (14)	4.3 (0.2)	123.1 (6)	101.3 (5)	71.6 (3)
Towns	44392.0 (95)	25787.9 (58)	3150.4 (7)	2547.7 (6)	2747.7 (6)	4999.8 (11)	3540.7 (8)	1582.0 (4)
Villages	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL	46533.6	27119.0 (59)	3368.7 (7)	2839.8 (6)	2752.0 (6)	5122.9 (11)	3642.0 (8)	1653.6 (4)

The wetland area by class in ha and as a percent of the total wetland area for regions and counties are listed in Table 4.5. Percentages were estimated by dividing the wetland area with the total municipal land area and multiplying by 100. For regions, Waterloo contains the largest area of Class 1 wetlands in hectares, although Hamilton-Wentworth has at 81%, the largest area as a percent of the regions' area in the watershed. Three-quarters of all the wetlands in Wellington County are Class 1. Perth County has the smallest area of provincially significant wetlands at 2 % of its land coverage. The table suggests that as all of the upper tier municipalities have provincially significant wetlands, the official plans for these municipalities should have policies indicating no development within the Class 1-3

Table 4.5: Total Wetland Area by Class in Hectares and as a Percent for the Regions and Counties (1997)

		Class						
MUN	TOTAL	1 (ha) (%)	2	3	4	5	6	7
Halton	1322.4 (12)	369.2 (28)	n/a	n/a	355.5 (27)	476.5 (36)	n/a	121.2 (9)
H-N	2848.5 (26)	1421.3 (50)	938.7 (33)	309.0 (11)	n/a	n/a	111.5 (4)	67.9 (2)
H-W	1353.7 (12)	1099.2 (81)	n/a	n/a	165.7 (12)	12.2 (1)	59.9 (4)	16.7 (1)
Water.	5602.5 (50)	3299.4 (58)	433.0 (8)	345.5 (6)	373.3 (7)	791.2 (14)	319.6 (6)	35.8 (1)
TOTAL	11127.1 (100)	6189.2 (56)	1371.7 (12)	654.5 (6)	894.5 (8)	1280.0 (12)	490.9 (4)	241.8 (2)
Brant	4671.9 (13)	3092.4 (66)	n/a	483.3 (10)	169.8 (4)	448.0 (10)	309.2 (6)	168.9 (4)
Well.	17207.3 (49)	13113 (76)	690.2 (4)	245.8 (1)	654.1 (4)	2216.3 (13)	178.8 (1)	102.3 (1)
Oxford	4638.1 (13)	2986.8 (64)	586.2 (13)	181.8 (4)	350.2 (8)	249.9 (5)	98.8 (2)	184.4 (4)
Perth	221.6 (1)	n/a	5.1 (2)	n/a	93.7 (42)	2.0 (1)	120.8 (56)	n/a
Duff.	7960.2 (22)	1738.1 (22)	715.5 (9)	575.8 (7)	589.5 (7)	926.7 (12)	2439 (30)	951.7 (12)
Grey	707.9 (2)	n/a	n/a	698.7 (98)	n/a	n/a	4.5 (1)	4.7 (1)
TOTAL	35407.0 (100)	20930.2 (60)	1997.0 (6)	2185.3 (7)	1857.3 (1)	3842.9 (11)	3151.1 (10)	1412.0 (5)

wetlands. As all of the upper tier municipalities also have regionally or locally significant wetlands, the table suggested that the encouragement to protect other wetlands would be appropriate.

Appendix I lists the wetland area by ha and as a percent of the total wetland area by

class of wetlands for the 55 lower-tier municipalities and Tuscarora. Percentages were estimated by dividing the wetland area with the total municipal land area and multiplying by 100. Eramosa has the most Class 1 wetland by area followed by Dunnville with the most Class 2 wetland; Proton with the most Class 3 wetland; Amaranth the most Class 4 wetland by area; Erin with the most Class 5 wetland and Melancthon with the most Class 6 and 7 wetland by area. South Dumfries has the largest area of Class 1 wetland; Dunnville has the largest area of class 2; North Dumfries has the largest area of class 3 and 6 wetlands; Guelph Township has the largest area of class 4; Woolwich the largest area of class 5 and Burford the largest area of class 7 wetlands. By measuring the wetland area by class for each lower-tier municipality, the information indicates the distribution of provincially significant, regionally significant and locally significant wetlands throughout the lower-tier municipalities. Mapping shows that 43 municipalities have wetlands within their municipal boundaries and of those, 33 municipalities have provincially significant wetlands. This information should guide wetland protection policies within the watershed, by integrating such information into the local official plans and schedules.

4.3 Number of Wetlands

The number of wetland polygons was determined for each municipality. The total number of wetland polygons within the watershed as determined by this study is 1528. According to the OMNR Wetlands Inventory database listed in Appendix J, there are 220 named and evaluated wetlands The largest number of wetlands are found within the following complexes:

(1) **Glen Morris Ridge Wetland Complex** -Brant County/Waterloo Region-North & South Dumfries

(2) **Sheffield-RocktonWetlandComplex**-Hamilton-Wentworth/BrantCounty-Flamborough, Cambridge & North Dumfries
(3) **Speed River Complex**-Wellington/Dufferin County-Erin
(4) **Central Whiteman's-Horner Creek**-Brant/Oxford,County-Burford, Blandford-Blenheim
(5) **Ballinafad Ridge**-Wellington-Erin

Wetland complexes are two or more individual wetland areas along with their adjacent lands, that are related in a functional manner and are grouped within a common wetland boundary. The whole complex is evaluated and classified, not its individual wetland area components (OMNR, 1992).

The total number of wetlands by class within the upper- and lower-tier municipalities and within the regions and counties could not be listed. Since wetlands do not conform to municipal boundaries, the total number of wetlands within each local municipality is greater than the total number of wetland polygons for the watershed. These numbers reflect the 130 wetlands shared by two or more municipalities. To obtain the total number of wetlands by class for the upper tier and lower tier municipalities would have created an error as the same wetland may have been included more than once when adding the wetlands within municipalities.

Appendix K lists the number of wetlands by class for the local municipalities. The table illustrates that South Dumfries, North Dumfries, Burford and Blandford-Blenheim have the largest total number of wetland polygons, respectively. With the exception of Burford, the wetlands tend to be provincially significant. Paris, Ellice, Fergus and Mornington have fewer than 2 wetlands within their municipal boundaries.The table indicates that there are numerous areas of provincially significant wetlands, many forming wetland complexes within a municipality and between municipalities. These areas may be

fragments of once larger, more homogenous wetlands. Ongoing longterm degradation may have more impact on smaller wetlands over a given time frame than for a larger wetland. As such, policies within municipalities experiencing development or contributing non-point source pollution to wetlands should be reviewed before these remaining wetlands are lost.

Table 4.6 illustrates the frequency of the total number of Class 1-7 by class for the lower-tier municipalities. The majority of municipalities do not contain or share any wetlands. Of the 32 remaining municipalities, the most frequent class by number of polygons is 1 - 20 for the Class 1 wetlands. One municipality has over 100 + Class 1 wetlands, while 5 municipalities have between 41-60 wetlands. Between 10 and 15 municipalities have or share 1-20 Class 2 and 3 wetlands.

The frequency of regionally or locally significant wetlands by class for lower tier municipalities are also listed in Table 4.6. The number of municipalities without Class 4-7 wetlands ranges from 42 to 32. For the remainder, the second most frequent number class is 1 - 20 wetlands followed by 21- 40 wetlands. There are no municipalities with 41 or greater regionally or locally significant wetlands. This information indicated that many municipalities do not have certain classes of wetlands, also represented by classifying the total wetland area by class and in ha, as previously described. By knowing the number of wetlands, municipalities can determine the average size of the wetlands in any given class. Therefore, policies can be directed specifically at those municipalities with the large number of provincially significant wetlands and those with few wetlands to ensure that the remaining wetlands are protected.

Table 4.6: Frequency of Total Number of Class1-7 Wetlands by Class for Lower-Tier Municipalities (1997)

Number	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
	Freq.						
0	24	41	46	42	32	39	39
1-20	20	13	8	12	21	16	16
21-40	2	2	2	2	3	1	1
41-60	5	0	0	0	0	0	0
61-80	4	0	0	0	0	0	0
81-100	0	0	0	0	0	0	0
100 +	1	0	0	0	0	0	0

4.4 Contributing Area

Table 4.7 summarizes the high, moderate and low total contributing areas in ha and as a percent of the total land area within the upper- and lower-tier municipalities. Measurement of the total contributing area at both levels of municipal government identifies the extent of the contributing area to determine the need to focus decision-making, at this upper level of government based on the significance of the wetland area. The total contributing areas within the categories of high, moderate and low were calculated by adding the respective contributing areas within each local municipality shown in Appendix L.The table indicates that 9.5 % of the watershed contributes non-point source pollution overland to wetlands. Counties comprise 11.3 % of the total area contributing non-point source pollution, as compared to the regions with 6.8 %. Percentages were calculated by taking the total contributing areas and dividing by the total area of the municipality. Five percent of the total contributing area for regions and counties is considered low contributing area. Towns and townships contribute 10.2 % total area with 5.6 % low contributing area.

The low contributing area represents the largest contributing area for the entire watershed. Although much of the contribution may be ranked low, cumulatively the contribution of sediment and associated contaminants will still impact the wetlands, over a longer period of time. Of concern, is the high contributing area from counties and towns/townships. Towns and cities contribute 3.1% and 1.6 % of the high amounts of non-point source pollution. Policies and zoning guiding development, whether agricultural or urban growth, adjacent to wetlands and within towns/townships and counties should emphasize this concern.

Table 4.7: Total Contributing Area within the Upper- and Lower-Tier Municipalities (1997)

MUN	High		Mod		Low		TOTAL	
	Ha	%	Ha	%	Ha	%	Ha	%
Region	9913.4	2.0	3214.2	0.6	21468.4	4.2	505921	6.8
County	26743.7	3.6	14483.2	1.9	43655.1	5.8	749475	11.3
TOTAL	36657.1	2.9	17697.4	1.4	65123.5	5.2	1255396	9.5
Cities	2196.7	1.6	240.6	0.2	4488	3.2	140413	4.9
Towns	34460.4	3.1	16849.8	1.5	62103	5.6	1113582	10.2
Villages	n/a	0	n/a	0	n/a	0	1400	0
TOTAL	36657.1	2.9	17697.4	1.4	65123.5	5.2	1255396	9.5

Table 4.8 shows the total contributing area by regions and counties in ha and as a percentage of the municipalities' total land area, as represented in the watershed. Counties with the large rural land base contain 11.3 % of the contributing area for the entire watershed, with 19.9 % in Wellington County. The Region of Waterloo at 138, 395 ha has the largest total area of the regions contributing non-point source pollution. It also has the

largest total area of high and low contributing area. Dufferin County has the third largest contributing area of the regions and counties. Although, the Region of Hamilton-Wentworth has a small area in the watershed mainly in Flamborough, it contains 1.8 % of the moderate contributing area. The information in this table suggests that all regions and counties contribute non-point source pollution and should have policies on development adjacent to wetlands. Wellington County, Waterloo Region and Brant County with the largest high contributing area should have the strongest policies guiding development adjacent to wetlands.

Table 4.8: Total Contributing Area by Regions and Counties (1997)

MUN	TOTAL		High		Mod		Low	
	Ha	%	Ha	%	Ha	%	Ha	%
Regions								
Halton	64705	7.3	591.0	0.9	229.4	0.4	3930.7	6.1
H-N	232733	1.8	1489.1	0.6	672.5	0.3	2019.1	0.9
H-W	70086	4.6	1369.7	2.0	1247.1	1.8	625	0.9
Water	138395	16.2	6463.6	4.7	1065.2	0.8	14893	10.7
TOTAL	505921	6.8	9913.4	1.9	3214.2	0.6	21468	4.2
County								
Brant	110504	12.1	4806.8	4.3	1478.7	1.3	7139.8	6.5
Well	237573	19.9	16013	6.7	7869.9	3.3	23377	9.8
Oxford	108571	6.9	2448.2	2.2	1703.4	1.6	5377.5	4.9
Perth	138393	0.4	169.9	0.1	170.7	0.1	232.3	0.2
Duff	90813	14.6	3063.5	3.4	3095.9	3.4	7239.9	8.0
Grey	63621	1.1	241.5	0.4	164.6	0.3	288.5	0.5
TOTAL	749475	11.3	26743	3.6	14483	1.9	43655	5.8

The total area of high, moderate and low contributing area is also listed in Appendix L. Eramosa contains the largest total area of high, moderate and low contributing area in hectares. The entire municipality is contained within the Grand River watershed. Eramosa is followed by Puslinch, Erin, Blandford-Blenheim and North Dumfries. Eramosa also experiences the largest total area of contributing area as a percentage of the total area of the township. The Town of Milton has 73.1 % of its area contributing non-point source pollution, if calculated based only on its area within the watershed. Erin, Puslinch, Halton Hills and Burford have the largest total contributing areas as a percentage of their area represented in the watershed. Twelve municipalities do not contribute any nonpoint source pollution to the wetlands. These tables suggest that almost all of the municipalities should incorporate in their official plans, policies guiding development or activities adjacent to wetlands.

Table 4.9 indicates the frequency of the total contributing area of the local municipalities. Between 1-2000 ha of land contributes non-point source contaminants for

Table 4.9: Frequency of Total Contributing Area by Lower Tier Municipality (1997)

Area (ha) Class	Frequency
0	11
1-2000	26
2001-4000	8
4001-6000	5
6001-8000	1
8001-10 000	4
10 000+	1

twenty-six municipalities. Due to the lack of wetlands, eleven municipalities consisting mainly of villages do not contribute contaminants overland directly to wetlands. Eight municipalities have between 2001 - 4000 ha of contributing area. Six municipalities have 6 000 ha or more total contributing area. Since many of the total contributing areas are small, the opportunity to apply conservation practices or limit development should be relatively simple and inexpensive.

Table 4.10 summarizes the frequency of the high, moderate and low contributing areas of the local municipalities. The most frequent class at twenty-nine municipalities is 1-500 ha in size of moderate contributing area. This class is also the most frequent for high and low contributing areas. However, there are 12 municipalities with 2001+ ha of low contributing area. This table indicates that the majority of municipalities should be able to protect wetlands relatively simply since the areas

Table 4.10 : Frequency of Total High, Moderate and Low Contributing Area by Lower-Tier Municipality (1997)

Class	High	Moderate	Low
(ha)	Frequency	Frequency	Frequency
0	12	16	12
1-500	19	29	16
501-1000	11	5	9
1001-1500	7	5	4
1501-2000	4	0	3
2001+	3	1	12

contributing non-point source pollution directly to wetlands is small and the amount is less than 2 tonnes/hectare/year. However, many municipalities have high contributing areas,

which should be a concern to these municipalities, since several have large expanses of high contributing areas. Policies should be directed to those municipalities.

As a percentage of the area within the watershed, the frequency of high, moderate and low contributing areas are listed in Table 4.11. The majority of municipalities have between 0.0 and 5.0 % of their area contributing high, moderate and low volumes of non-point source pollution. Eight municipalities with area within the watershed contains 25.0 % or more of its area contributing low volumes of non-point source pollution.

Table 4.11: Frequency of High, Moderate and Low Contributing Area as a Percentage of the Area within the Watershed (1997)

Class	High	Moderate	Low
(%)	Frequency	Frequency	Frequency
n/a or 0	14	22	14
0.1-5.0	22	27	13
5.1-10.0	12	6	12
10.1-15.0	6	0	5
15.1-20.0	0	1	1
20.1-25.0	2	0	3
25.1-30.0	0	0	2
30.1+	0	0	6

4.5 Development Pressure Indicators

Population and dwelling densities were used as indicators of development within the watershed. This was used as population grows, there is an increased demand for services, including residential development. The dwelling density reflects the residential development built to meet the needs of the population through infilling, subdivision plans or accelerated severance applications.

4.5.1 Population Change

The demand for development is a function of the local economy and the degree of urbanisation. For some large river systems, development is attracted, in part, by the amenity value of the valley environment (Millerd et al., 1994). Table 4.12 presents the population changes from 1986 to 1994 for the regions and counties within and outside of the watershed. These dates were chosen as they corresponded to the period of comprehensive policy development and implementation for wetlands protection. The population values within the watershed are provided by the populations of those municipalities with land drained by the Grand River and its tributaries. Census information for populations were provided by Statistics Canada data. For the population outside of the watershed, regions and counties with other lower tier municipalities not represented within the watershed are included. It is evident that there is a slightly larger change in population in the municipalities within the watershed than in those municipalities outside of the watershed. The regions, possibly due to the higher concentration of the population in the cities experienced a slightly larger change in population than the counties. Since there is a growing population within the watershed, it would seem to indicate that additional pressures would be placed on the natural systems. The table illustrates how the river basin attracts people to settle. This settlement pattern adds pressure by requiring land to supply services for urban runoff, food production and waste disposal sites.

Table 4.12: Population Changes from 1986-1994 for the Regions and Counties represented by the Municipalities within and outside of the Watershed (1997)

MUN	Population (1986)	Population (1994)	Population (1986)	Population (1994)	% Change '86-'94	% Change '86-'94
	Within watershed		Outside watershed		Within watershed	Outside watershed
Halton	67606	69041	271389	315557	+2.1	+15.4
H-N	49492	55133	90121	96671	+11.4	+7.3
H-W	52998	62748	423398	457687	+18.4	+8.1
Waterloo	329404	383319	329404	383319	+16.4	+16.4
TOTAL	499500	570241	114312	1253234	+12.1	+11.8
Brant	102299	109645	106267	109904	+7.2	+3.4
Wellington	126612	148463	139447	169348	+17.3	+21.4
Oxford	23352	24829	85364	94959	+6.3	+11.2
Perth	17660	18428	66597	69601	+4.3	+4.5
Dufferin	8852	10107	32650	40997	+14.2	+25.6
Grey	4522	5345	74759	61124	+7.2	(18.2)
TOTAL	283297	316817	505084	545933	+11.3	+8.0

Table 4.13 lists the population density change from 1986-1994 for the upper- and lower-tier municipalities. As would be expected, cities experienced the highest density of 5 people per ha.The lower-tier municipalities had a larger growth in population than the upper-tier municipalities. Densities from 1986-1996 for lower- tier municipalities were also higher than for upper-tier municipalities. The population and density of all of the lower-tier municipalities within the watershed is listed in Appendix M. Increasing pressures from urbanization may force municipalities to deal more frequently with issues of development and impact assessment review.

Table 4.13 : Population Density Change for Upper- and Lower- Tier Municipalities from 1986-1994 (1997)

MUN	Area (ha)	Population (1986)	Population (1994)	Density (1986)	Density (1994)	% Change ('86-'94)
Regions	448575	499501	570241	1.11	1.27	+12.1
Counties	700036	283297	316817	0.40	0.45	+11.25
TOTAL	1148611	782798	887058	0.75	0.82	+11.7
Cities	112989	463825	565138	4.10	5.00	+21.8
Towns	1034328	310660	342957	0.30	0.33	+10.4
Villages	1294	8313	9635	0.16	0.13	+15.9
TOTAL	1148611	782798	887058	1.52	1.82	+16.0

The population density change from 1986-1994 for regions and counties is shown in Table 4.14. Regions experienced a slightly larger growth in population than the counties. The population of three of the four regions grew by 10-20 %. Grey, Wellington and Dufferin Counties had populations that expanded by 14-18 %. The largest density of population for the regions and counties is within the Regional Municipality of Waterloo. This may be due to the populations within the cities of Kitchener, Waterloo and Cambridge. Densities increased for all of the upper-tier municipalities.

Table 4.14: Population Density Change for Upper-Tier Municipalities from 1986-1994 (1997)

MUN	Area (ha)	Population (1986)	Population (1994)	Density (1986)	Density (1994)	% Change ('86-'94)
REGIONS						
Halton	64306	67607	69041	1.05	1.07	+2.1
H-N	161579	49492	55133	0.31	0.34	+11.4
H-W	86719	52998	62748	0.61	0.72	+18.4
Waterloo	135971	329404	383319	2.4	2.8	+16.4
TOTAL/ MEANS	448575	499501	570241	1.11	1.27	+12.1
COUNTIES						
Brant	91533	102299	109645	1.12	1.20	+7.2
Wellington	234962	126612	148463	0.53	0.63	+17.3
Oxford	101029	23352	14829	0.23	0.25	+6.3
Perth	118665	17660	18428	0.15	0.16	+4.3
Dufferin	90497	8852	10107	0.10	0.11	+14.2
Grey	63350	4522	5345	0.07	0.08	+18.2
TOTAL/ MEANS	700036	283297	316817	0.40	0.45	+11.25

The frequency of populations for the lower-tier municipalities are provided in Table 4.15. Most municipalities have populations between 1-10 000. There are 5 municipalities with over 60 000 people and 5 between 10 000 and 20 000. No municipalities have populations, at this time, between 20 000 - 40 000. Thirty-nine municipalities are between 1-10 000 in population class size. The second most frequent population class is 10 0001-20 000 and for those municipalities with populations larger than 60 001.There was no population available for the Six Nations lands. For the majority of the watershed municipalities, the population is small, but gradually growing in population.

Table 4.15: Frequency of Populations for Lower Tier Municipalities (1997)

Population Class	Frequency
n/a	1
1-10 000	39
10 001-20 000	5
20 001-30 000	4
30 001- 40 000	2
40 001-50 000	0
50 000-60 000	0
60 001+	5

4.5.2 Dwelling Density

Table 4.16 lists the number and density of dwellings from 1991-1994 for the upper- and lower-tier municipalities. It is evident from the table that lower-tier municipalities have the greatest density of dwellings as compared to upper-tier municipalities. This may be due to the limited number of values within the lower-tier municipalities. With the population growth experienced within the watershed, the density of dwellings also increased. The density of dwellings in the villages expanded more than within the cities. There was only a slight change in the density of dwellings within the regions and counties. A similar pattern was found for the number and dwelling density within the regions and counties.

Table 4.17 lists the number and density of dwellings within the regions and counties. All of the regions experienced an increase in density of dwellings between 1986 - 1994. However, only Brant and Wellington counties grew over this period. These municipalities have undergone rapid urbanization especially within the cities within their boundaries. Such

Table 4.16: Number and Density of Dwellings by Upper- and Lower-Tier Municipalities (1997)

MUN	Area (ha)	# Dwellings (1991)	# Dwellings (1994)	Density of Dwellings (1991)	Density of Dwellings (1994)
Regions	448575	196702	217926	0.44	0.49
Counties	700036	109224	119564	0.14	0.15
TOTAL	1148611	305926	337490	0.30	0.32
Cities	112989	192546	203374	1.70	1.80
Towns	1034328	104665	121755	0.10	0.12
Villages	1294	3527	3802	2.73	2.94
TOTAL	1148611	300738	328931	1.51	1.62

pressures may force staff to become knowledgable about planning and development impacts.

Table 4.17: Number and Density of Dwellings within the Regions and Counties (1997)

MUN	Area (ha)	# Dwellings (1991)	# Dwellings (1994)	Density of Dwellings (1991)	Density of Dwellings (1994)
Halton	64306	22291	24117	0.35	0.38
H-N	161579	19131	23049	0.12	0.14
H-W	86719	19582	21333	0.23	0.25
Waterloo	135971	135698	149427	1.00	1.10
TOTAL	448575	196702	217926	0.43	0.47
Brant	91533	40000	43338	0.44	0.47
Wellington	234962	50368	55668	0.21	0.24
Oxford	101029	7877	8414	0.08	0.08
Perth	118665	5568	5922	0.05	0.05
Dufferin	90497	3214	3724	0.04	0.04
Grey	63350	2197	2498	0.04	0.04
TOTAL	700036	109224	119564	0.14	0.15

4.6 Summary

The assessment of the distribution of wetlands and non-point source contributing areas provided insight into where the wetlands are found within the upper- and lower- tier level municipalities. This analysis indicated on a watershed approach and based on municipal boundaries, the municipalities which should have concerns due to the number or area of wetlands and the extent of contributing areas of nonpoint source pollution. Chapter 5 is an assessment of the municipal staff survey and the official plan policy review. A discussion on the integrated analysis from the results of Chapter 4 and 5 is considered in Chapter 6.

CHAPTER 5: MUNICIPAL SURVEY RESULTS AND POLICY REVIEW

5.0 Introduction

This section presents the results of the survey of municipal staff and policy review. Responses to each question are discussed separately. For open-ended questions, the responses were categorized and ranked according to the number of times they were raised by each respondent. General comments to the survey were also collected.

5.1 Response Rate

Of the 66 questionnaires mailed out, 41 responses were returned. This represents an overall response rate of 62.1%. Table 5.0 lists the response rate based on the level of local municipality. Due to the survey method, 15 questionnaires were returned with only question 1 and 2 completed. Respondents were asked to list the number of years they had worked in planning. The average number of years was calculated by totalling the number of years and dividing by the number of respondents. The average number of years planning experience of the staff was 11.1 years. This indicated a level of familiarity with planning and policy implementation.

Table 5.0: Response Rate of Questionnaire by Municipality (1997)

Level of Municipality	Number Mailed	Number Returned	Percent Returned
Regions	4	3	75 %
Counties	6	6	100 %
Cities	6	5	83%
Towns & Townships	45 (8, 37)	27 (6, 21)	75 % 57 %
Villages	5	0	0 %
TOTAL	66	41	62.1 %

Of all the municipalities, villages had the lowest response rate at 0 %. This may be attributed to the lack of wetlands within village boundaries or possibly a lack of personnel to respond to the questionnaire. Counties had the highest response rate.

5.2 Questionnaire Results

Question 1 & 2-Level of Municipal Government

All respondents were asked to indicate which level of municipality they represented. Responses to the question are listed in Table 5.0. Question 2 tried to determine whether in-house staff or others including another level of government or an outside consultant conducted land-use planning within their municipality.Thirteen towns and townships and two counties responded. Eight towns/townships replied that their county carried out the land use planning for their municipality. Planning consultants from outside of the municipalities planned for four towns/townships. For the two counties which responded, either a local municipality or planning consultant carried out land- use planning. These municipalities were asked to return their surveys and were not included in any further analysis. The response to the question indicated a variation in the methods and resources municipalities had to conduct land-use planning. This indicated that for these municipalities planning was not done by local municipal staff.

Question 3(a)-Agency Contact

Figure 5.0 shows the responses to Question 3 which asked respondents to identify the agency or agencies that the municipality might seek out for information regarding the protection of wetlands or planning adjacent to wetlands. Each response was given a point ranking based on the number of agencies considered in the question. Given more than one

Order of Contact

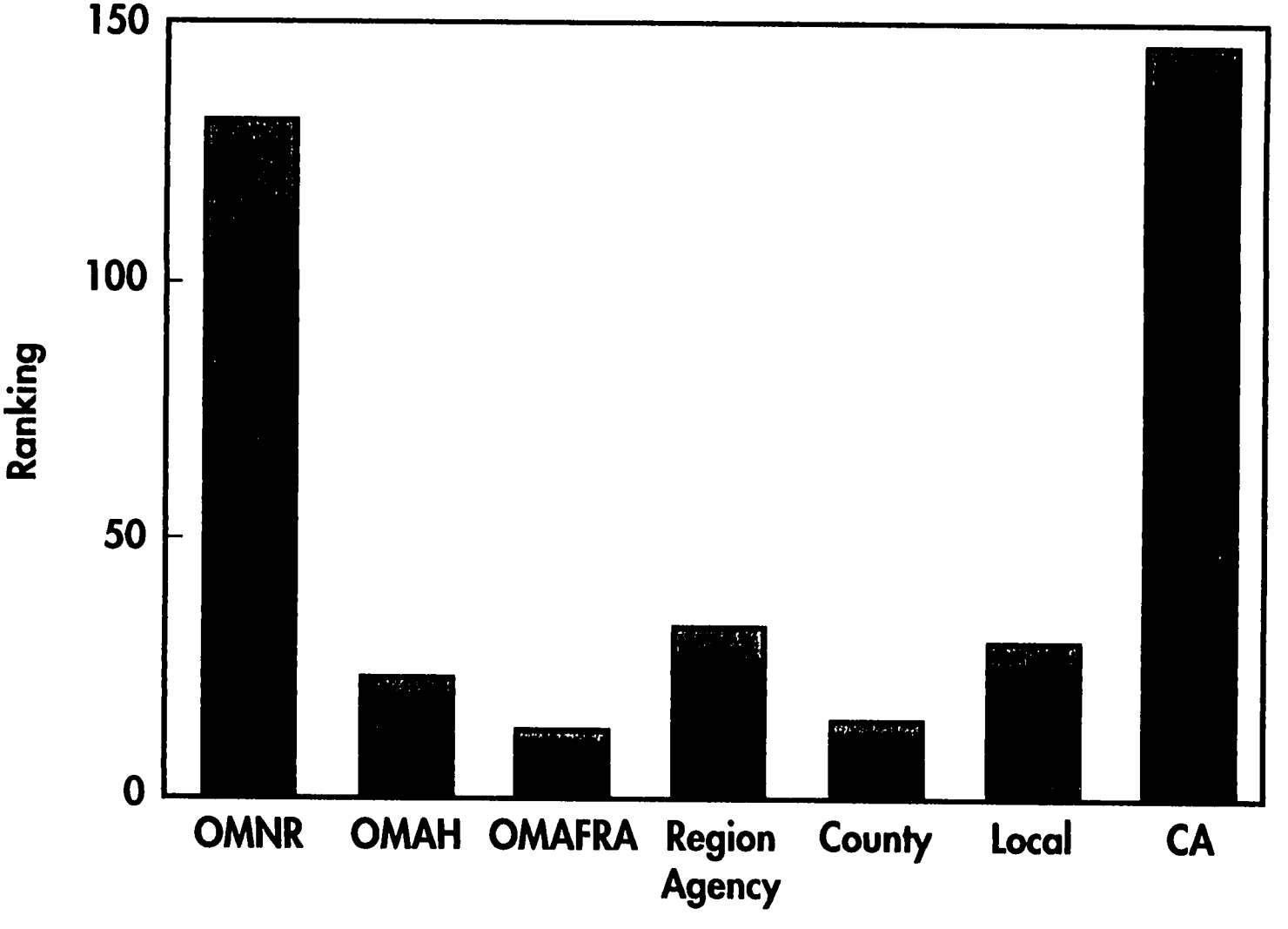


Figure 5.0: Order of Contact

agency, the respondents were able to state the order of contact with 1 being the first agency the respondent would contact and 2, the second agency etc. Of the 17 responses, the Grand River Conservation Authority (GRCA) was the 1st agency to contact, followed by the Ontario Ministry of Natural Resources (OMNR), region and local municipality. The Ontario Ministry of Municipal Affairs (OMMA), county and the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) was ranked 5th, 6th and 7th respectively. By asking the municipalities, which agency they would contact, provided an understanding of whom they would turn to for information or expertise on wetlands.

Question 3(b)-Ranking of Agency Effectiveness

Part (b) of Question 3 asked the respondents to rank the agencies in their strength to protect wetlands with 1 being the strongest and 7 the weakest. The GRCA followed by OMNR and OMMA were considered to be the agencies with the most strength. The local municipality, county, OMFRA and region, in this order, were those agencies with less strength to protect wetlands. There were also a variety of combinations. Of note, the order of contact was the same as the order of strength in 15 of 17 responses. It was interesting that municipalities considered themselves to have little strength to protect wetlands, although changes to the *Planning Act*, gave the municipalities more power to protect such areas and make day-to-day planning decisions.

Question 4-Relative Importance of Environment in Land use Planning

Question 4 sought to determine the balance of economic, environmental and social aspects in the decision making of municipalities. For most municipalities, economic reasons were considered the most important issue affecting land-use planning by respondents with

environmental planning, the least important concern. Three respondents stated that the environment and economy were equally most important, while three responded that all were equally important. One respondent chose a combination of the environment and the community as being equally important with the economy following second. The response to the question showed that economy plays an important role in the decision-making of many of the municipalities. For a smaller number of municipalities, an awareness of the impacts or needs of the environment, economy and society affected decision-making. Thus, managing population growth may be an important issue for municipalities, especially if economic values are more important.

Question 5-Sufficiency of Wetland Protection by Council

Question 5 asked whether sufficient or insufficient wetland protection was given by their council during deliberations of land-use planning applications. Twenty-four responded, with 83% stating that their council provided sufficient wetland protection. This corresponded to a response of either a 3.5 to a 5 on the scale. Thirteen percent considered council provided both sufficient and insufficient protection, while 4.2 % considered that wetlands were not considered during review of planning applications. One respondent commented on the possible respondent bias due to the unclear definition of sufficiency in the question. According to these responses, local councils are aware of the issues impacting wetlands. It was commented on by staff that they often provided wetland information to council, if it affected a development application. On this basis, it may be intimated that local decision makers apply knowledge about wetlands when making development decisions.

Question 6-Issues Impacting Effective Wetland Protection

Municipalities were provided with a list of possible issues impacting effective wetland protection. Responses to the question are illustrated in Figure 5.1. Disinterested landowners and a lack of understanding the value of wetlands were stated as being the issue with the greatest impact to wetland protection. This response suggested that a wetlands awareness program may be of merit to build interest in wetlands protection at a local level with the landowners. With a growing awareness of the values of wetlands within the public, decision-makers may begin to include other protection measures into the policies.

Question 7-Resources to Effectively Protect Wetlands

The municipalities were also asked whether they had resources to effectively protect wetlands. Given that the majority of respondents believed that council provided sufficient protection of wetlands in their deliberations of development applications, 50 % indicated that their municipality did not have the resources to effectively protect wetlands. Thirty-four percent stated they had the necessary resources through policies and staff expertise. These respondents tended to be within the higher populated areas of the watershed. Other municipalities felt that they had some resources, but not all of the necessary resources. Numerous comments were generated by this question and are listed in Appendix P. Upper-tier municipal support, strong local municipal official plan policies, up-to-date mapping and staff resources were considered the resources needed to provide an effective wetlands program. Municipalities requested additional financial and staff resources including expertise in EIS review, provincial policy support and up-to-date wetlands information to meet this objective.

Issues Impacting Effective Wetland Protection

at the Local Municipal Level

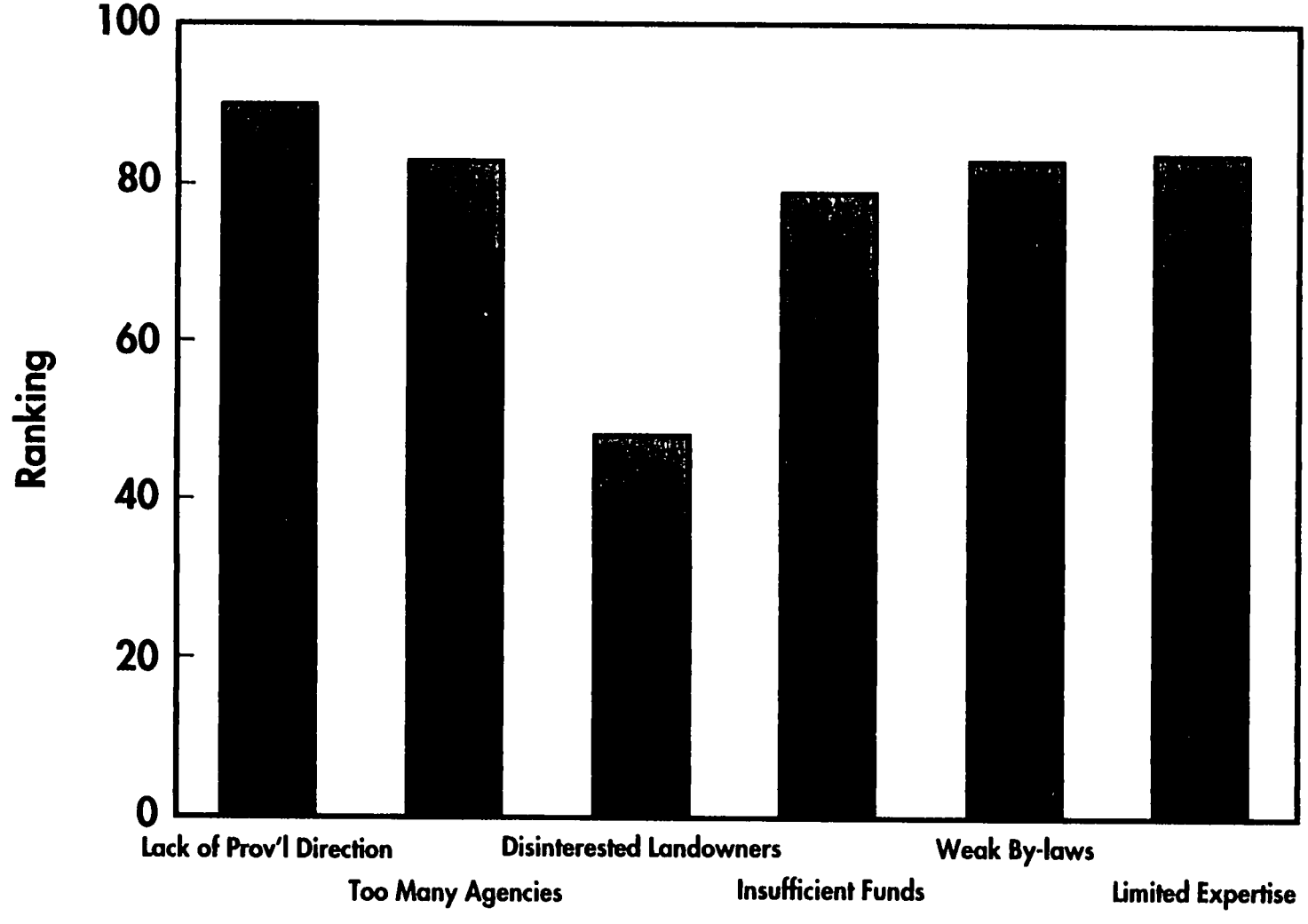


Figure 5.1: Issues Impacting Effective Wetland Protection

Question 8-Advisory Committee

To evaluate a possible venue for expertise in EIS review, Question 8 inquired whether the municipalities had a natural areas advisory committee. For 76 % of the respondents, there was no advisory committee. Twenty-four percent stated that they had a land-use planning committee including one respondent which had a committee assisting with the official plan review. An advisory committee formed from councillors, staff and public with local expertise, as utilized in Halton and Waterloo Region may be helpful to develop natural areas protection policies prior to adoption of the official plan and during deliberations of development applications.

Question 9 -Landowner Stewardship Program

Although there was a lack of money to fund a landowner stewardship program, 78% of the municipalities responded that a landowner stewardship program available through the municipalities would benefit wetlands. All of the respondents stated that there were no resources available at this time to support such a program, although this would be a useful method to inform landowners of the merits of wetland protection and assist in developing networks. The affects of changes by the present government and a need for more information would be required.

Question 10-Influence of Bill 163

Question 10 tried to determined the response rate to legislative changes by the municipalities. For 75 % of all respondents, Bill 163 had had no influence on wetland protection in their municipalities' wetland protection, while 18 % responded that the legislation would affect the municipality's official plan policies with regards to wetlands.

If changes were made in the planning process, almost all or 90 % of the respondents felt it would not impact the municipality's wetland protection. Many comments were also provided with this question and are found in Appendix P. The answers to the question indicated that legislative changes often do not have any effects if the municipalities are not in a position to review the official plan.

Question 11-Zoning Approaches

This question was added to determine if the municipalities would incorporate different approaches to wetland protection based on various development scenarios. Almost all of the municipalities responded that there would be no changes to the policies, the municipalities used followed by no development within a setback determined by the Province. The next approach the municipalities were willing to use was a buffered agriculture zone. Restricted development was the zoning approach the municipalities were least willing to use. This question indicated that either the municipalities believed that official plan policies were adequate for protecting wetlands or that setbacks determined by the Province would be used. Municipalities were also interested in using a buffered area to protect wetlands from agricultural activities. Information on the extent of contributing areas would be useful to the Province and municipalities in determining the width of either a setback or a buffer zone.

5.3 Questionnaire Summary

Surveying the municipal staff provided essential input on the attitudes and needs in the development of effective wetland protection from the perspective of the municipalities. For additional information, support or expertise, the municipalities contacted the

conservation authority, OMNR and regional municipality, respectively. The conservation authority, OMNR and OMMAH are considered the agencies with the most strength or legislative powers. Local municipalities responded that there was some expertise and strength to protect wetlands, more than at a county level of government.

Economy was the driving force affecting land use planning in municipalities, although for several municipalities the environment was also considered. Wetlands were often given sufficient protection by councils, although half of the municipalities do not have the resources to effectively protect wetlands. Disinterested landowners and a lack of understanding the value of wetlands are the issues with the greatest impact to wetland protection. From the municipalities' view, a lack of financial support and expertise on assessing EISs were the limiting factors to effective wetlands protection.

5.4 Official Plan Review Results

To assess the protection of wetlands, the official plan policies of all of the municipalities were reviewed based on the fulfilment of the requirements of wetland protection stated within the OWPS, the CSPS or the PPS. Each question was ranked from 1 to 5, as described in the Chapter 3, to address the adequacy of the policy in meeting the requirement. An assessment of the municipality to protection wetlands was based on the total ranking of the official plan review.

In order to ensure the most up-to-date official plan was reviewed, the municipalities were contacted through the survey and by phone. Appendix P lists the council adoption dates, the ministry approval dates and the possible period within which the municipalities will review their official plans. Table 5.1 summarizes the frequency of the dates of council

adoption of all of the municipal plans. As municipalities are now required under the *Planning Act* to undergo an official plan review every 5 years, official plans may be considered out-dated if the plans have not been rewritten within this time period. Since 1982, municipalities have been encouraged to include policies regarding wetlands.

The most frequent class of adoption dates is 1991-1995 with 22 municipalities. The second most frequent class is 1981-1985. According to the table, almost half of the municipalities have official plans pre-dating the OWPS. Five municipalities did not have an official plan as planning was conducted by another level of government (eg. County). For 19 communities responding to the question of the reviewal date, five would be undergoing a review within five years,

Table 5.1: Frequency of Official Plan Adoption Dates by Local Municipal Councils (1997)

Date Classes	Frequency
n/a	5
1976-1980	7
1981-1985	12
1986-1990	7
1991-1995	22
1996+	2

four within two years and the remainder were undergoing a review at present or would be soon based on restructuring of the county or the newly completed official plan for a region (eg. Waterloo).

Table 5.2 is the average ranking of the official plan assessment for the upper

Table 5.2: Average Assessment Ranking of the Official Plan Review for the Upper- and Lower- Tier Municipalities (1997)

MUN	Q#1	Q#2	Q#3	Q#4	Q#5	Q#6	TOTAL
Regions	4.5	4.25	4.25	5	4.5	4.5	27
Counties	3	3	3	3	3.3	3.3	18.6
MEAN	3.9	3.7	3.7	3.7	4	4	26.7
Cities	3.3	3.6	2.6	3.5	3.2	3.6	16.3
Towns	2.5	2.7	2.0	3.2	2.8	4.0	17.2
Villages	0.8	0.8	0.6	1	1	2.8	7
MEAN	2.2	2.4	1.7	2.6	2.3	3.5	14.7

and lower-tier municipalities. The average ranking of the official plan assessment was provided by adding the total assessment for each municipality represented within the upper- and lower-tier municipality and dividing by the number of municipalities within the category. Based on the total points given to the municipalities within the upper- and lower-tier municipalities, regions have the highest average ranking at 27. A ranking of between 21-30 is suggests that the municipality has a clear statement and effective policies to protect wetlands. Counties are slightly less effective with an average ranking of 18.6. Towns/townships and cities also have a ranking within 11-20. As expected, villages with no wetlands, have the lowest assessment ranking and least effective policies to protect wetlands. For five municipalities without an official plan, the class was n/a or unavailable for all of the questions. Figure 5.2 displays the total assessment scale of the official plan review for the upper-tier municipalities within the watershed.

Figure 5.3 illustrates the total ranking of the municipalities for the lower-tier municipalities. These total rankings were based on the assessment rankings for the lower-tier

FIGURE 5.2

Ranking of Upper Tier Municipalities from the Official Plan Review

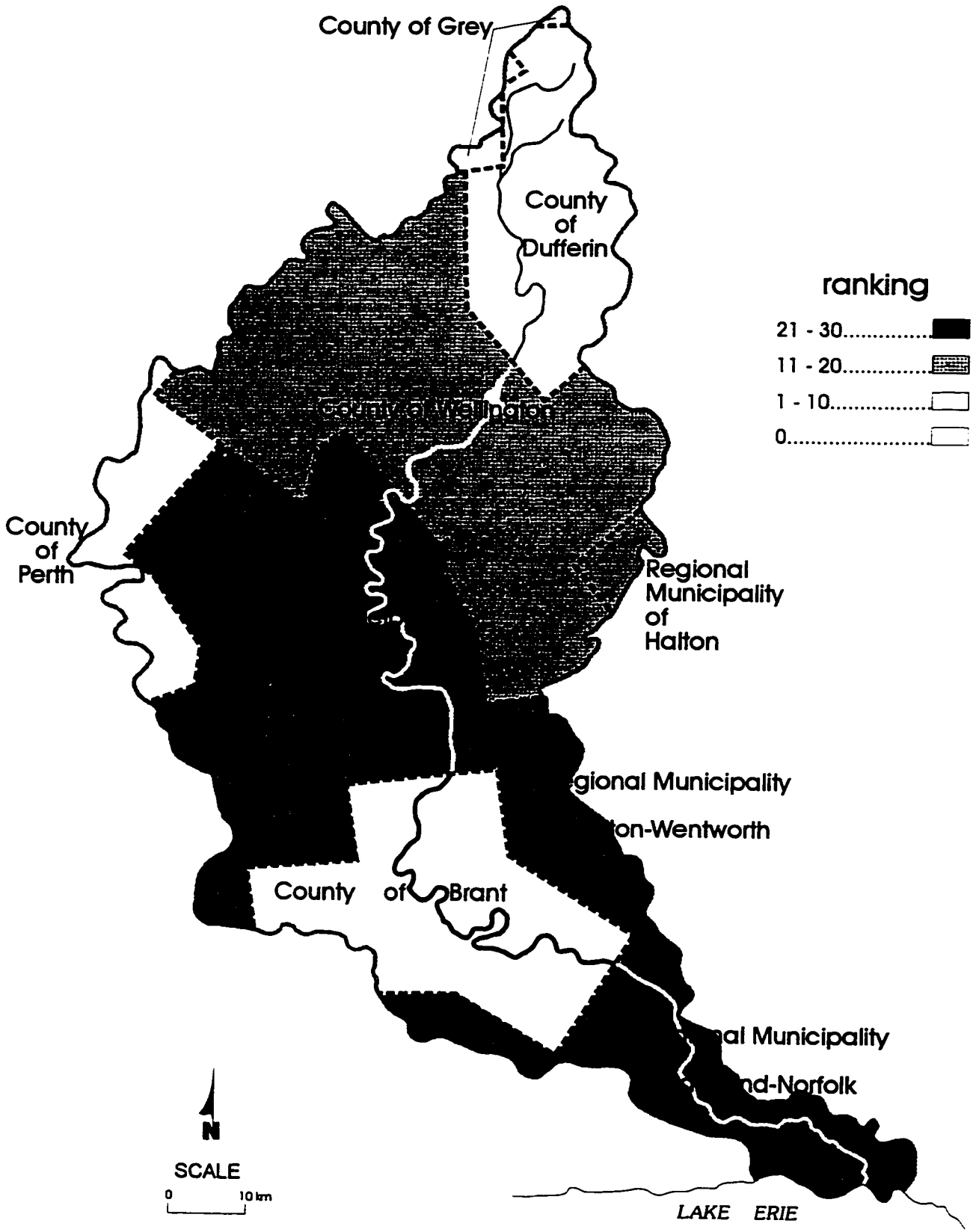
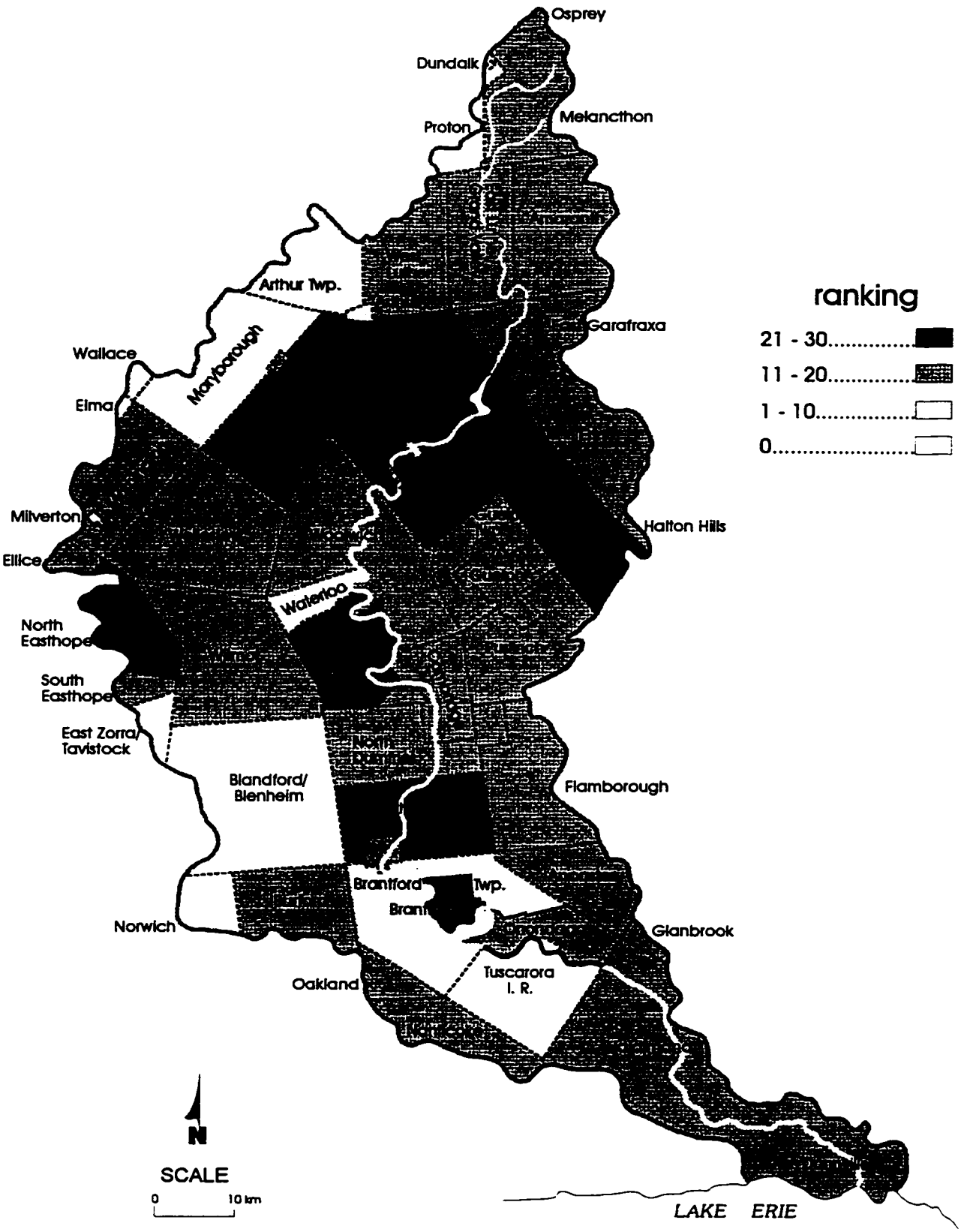


FIGURE 5.3

Ranking of Lower Tier Municipalities from the Official Plan Review



municipalities listed in Appendix Q. An evaluation of the lower-tier municipalities based on each question is outlined below.

Table 5.3 illustrates the frequency and ranking of the official plan review for the municipalities for each of the requirements the plan policies were assessed upon.

The following are the highlights of the official plan assessment review based only on the merits of the municipal policies.

Question 1-Incorporation of Provincial Wetland or Natural Heritage Policy Statements

Municipalities infrequently or inadequately incorporated the policies of the OWPS, CSPS or the PPS as it related to protection of wetlands, as the most frequent assessment ranking was 2 points. For 18 municipalities, the second and third most frequent scale class was 3 and 4 points. This means that half of the municipalities have weak or ineffective wetland policies. The remainder have included policies as encouraged by the provincial policy statements into their official plans. Therefore, it may be stated that few municipalities within the watershed recognize the value of wetlands through their official plans.

Question 2-Conformity to Prohibiting Development in Provincially Significant Wetlands

Question 2 sought to determine the number of municipalities to prohibit development within provincially significant wetlands. Twenty-three municipalities had an assessment class of 3 points or greater and so have clear policies restricting or prohibiting development. Fifty percent of the municipalities did not have clear policies within their official plans to prohibit development in provincially significant wetlands. Given that 75% of the

municipalities have provincially significant wetlands, protection is lacking in the official plans.

Question 3-Development in Adjacent Lands

The most frequent class for Question 3 is 2 points. Question 3 refers to the number of municipalities to permit development on adjacent lands within 120 metres of an individual wetland or all lands connecting individual wetlands within a wetland complex. Only 19 municipalities, slightly less than the two previous questions have two or less points for this question. Thus, more than half of the municipalities permit development on adjacent lands. Since the majority of wetlands have adjacent

Table 5.3: Frequency and Ranking of Official Plan Review by Area Municipality (1997)

Class	Q#1		Q#2		Q#3		Q#4	
	Freq.	Rank	Freq.	Rank	Freq.	Rank	Freq.	Rank
n/a	5	n/a	5	n/a	5	n/a	5	n/a
0	2	6	3	5	9	2	9	3
1	7	4	4	4	5	4	3	5
2	20	1	20	1	24	1	2	6
3	10	2	13	2	6	3	10	2
4	8	3	7	3	4	5	20	1
5	4	5	4	4	3	6	7	4

contributing areas, such information should be made available to the municipalities to make sound decisions to reduce the possible impacts due to non-point source pollution.

Question 4-Use of Environmental Impact Study

Question 4 tried to determine the number of municipalities to use an Environmental Impact Study or Assessment to demonstrate (1) no net loss of wetland functions; (2) create

subsequent demand for future development which would negatively impact existing wetland functions; (3) conflict with existing site specific wetland management practices; and (4) result in a loss of contiguous wetland area. Thirty-seven municipalities have 3 or more points refering to the use of an EIS. Therefore, the majority of municipalities require proponents to prove there will be no negative impacts or where there are impacts, that necessary mitigating measures to reduce the impacts. Although many of the municipalities required an EIS, the survey of municipal staff showed that expertise in properly reviewing the EIS may limit the value of the EIS unless other expertise is available.

Question 5-Additional Methods of Protection

Question 5 sought to ascertain the number of municipalities to have additional methods of support to protect wetlands. Twenty-one municipalities list wetlands under other policies besides a wetlands policy. Wetlands receive some protection under floodplain policies, if the wetlands were found within the areas protected by Fill, Construction or

Table 5.3: Frequency and Ranking of Official Plan Review by Lower-Tier Municipalities (1997)

Class	Q#5		Q#6		TOTAL		
	Freq.	Rank	Freq.	Rank	Class	Freq.	Rank
n/a	5	n/a	5	n/a	0	0	6
0	6	4	0	5	1-5	4	4
1	0	6	0	5	6-10	3	5
2	12	2	3	4	11-15	12	2
3	21	1	8	2	16-20	19	1
4	10	3	33	1	21-25	8	3
5	2	5	7	3	26-30	3	5

Alteration to Waterways policies from conservation authorities through the *Conservation Act*. Many municipalities also categorize wetlands as organic soils and give some level of protection as hazardous lands preventing some development. This indicates that wetland policies are not clearly stated as wetlands, but as organic or hazardous lands, as often observed in the older official plans (eg. pre-1985).

Question 6-Additional Agency Support

This question was added to find if another agency was referred to or their regulations were incorporated to provide additional support to protect wetlands. All of the municipalities referred to another ministry, usually the OMNR or the conservation authority for providing comments for development in or adjacent to wetlands, or hazardous lands, if the wetland may be located in these areas. A lack of expertise at the local level or the request for support may be signified by the response to this question.

5.5 Summary

The purpose of the official plan review was to examine the acceptibility of the OPWS or other policies respecting protection of wetlands or natural features. Half of the municipalities have policies meeting or are more stringent than the standards of the OWPS, CSPS or PPS. These municipalities have clear statements to prohibit development from provincially significant wetlands, but permit development on adjacent lands provided an EIS is supplied by the proponent. Although the other half of the municipalities may have ineffective or ambiguous policies, according to the official plan, all sought support from the OMNR or local conservation authority when faced with a development issue within or adjacent to a wetland. Expertise and support from the Province would provide for the

building of local knowledge. This would be useful when dealing with the general public.

CHAPTER 6: DISCUSSION

6.0 Introduction

The purpose of this chapter is to discuss the issues of concern with the municipalities, due to the identification of the wetlands and contributing areas, the pressures of population growth and dwelling density, the staff survey and the official plan review. Each issue will be examined to identify weaknesses or limitations for the effective protection of the wetlands within the Grand River watershed.

6.1 Valuation of the Municipal Policies in Terms of the Wetlands

The Federal Policy on Wetland Conservation outlines seven strategies to provide for the wise use and management of wetlands so that they can continue to provide a broad range of functions on a sustainable basis. Included in these strategies was the need to ensure a sound scientific basis for policy- making. Mitsch (1994) found that the integration of wetland protection into watershed planning is rarely used and that government regulations and policies better need to reflect wetland science including the definitions of wetlands, criteria for delineating wetlands and guidelines for permitting individual activities.

In order to properly plan and protect wetlands, municipalities must be able to assess the possible impacts that development may have on a wetland. The primary means of achieving this is through either a comprehensive or site impact assessment (IA). A major component of the provincial policy statements, the results offer decisions-makers important information on whether a development proposal may impact a provincially significant wetland.

A primary objective of the study was to assess the wetlands within the Grand River

watershed in terms of providing strong scientifically backed research on the possible impacts to the wetlands. The results of the functional analysis are listed in the the following three tables.

6.1.1 Functional Analysis of Upper- and Lower-Tier Municipalities

Table 6.0 summarizes the functional analysis at the upper- and lower-tier municipal level. Included in the analysis is the area of the wetland as a percent of the total watershed wetland (WET), the extent of provincially significant wetlands (PRO) and other wetlands (REG), the population (POP) and dwelling density (DWL) values over a given time period and the ranking of the official plans (POL).

Table 6.0: Policy Assessment Relative to Indicators in Upper- and Lower-Tier Municipalities (1997)

MUN	WET	PRO	REG	CON	POP	DWL	POL	FIN
Region	24	74	26	7	+12	+0.05	27	TA
County	76	72	28	11	+11	+0.01	19	IA
TOTAL /MEAN	100	72	28	10	+12	+0.02	23	A
Cities	5	86	14	5	+22	+0.10	16	IA
Towns	95	71	29	10	+10	+0.02	17	IA
Villages	n/a	n/a	n/a	0	+16	+0.21	7	A
TOTAL /MEAN	100	72	28	9	+16	+0.11	15	IA

where WET is the wetland area as a percent of the total wetland area
PRO is the Class 1-3 wetland area as a percent of the total wetland area
REG is the Class 4-7 wetland area as a percent of the total wetland area
CON is the contributing area as a percent of the total contributing area
POP is the change in population from 1986-1994
DWL is the change in dwelling density from 1986-1994
POL is the total ranking of the policy assessment
FIN is the final assessment of the municipalities based on all the indicators

n/c no change
n/a not available
TA totally adequate, could incorporate findings of this study
A adequate, review of the plan and findings soon
IA inadequate, needs review of the plan and findings as soon as possible
TI totally inadequate, requires review of the plan immediately
+ increase
- decrease

A final functional analysis is provided by FIN to indicate, based on a judgement of all indicators, whether the official plans adequately addressed wetland protection in its municipality given past population changes, the distribution and significance of wetlands. In reviewing the table, it was difficult to develop an analysis category including all indicators, as each indicator could impact the assessment. Therefore, municipalities were analysed separately. Overall, the official plan policies within the Grand River watershed need improvement. Given that (a) the majority of the wetlands are provincially significant, (b) the contributing area is 10% or greater for the watershed and has (c) experienced a population increase, the policy assessment for the upper tier municipalities was considered to be adequate, but could do with some review. Specifically, counties with 76 % of the wetland coverage, a large contributing area and population growth may be inadequate to effectively protect wetlands. Regional plans provided the most support for wetland protection, even with the third highest dwelling density increase. This analysis presented itself during assessment of the regional official plans in Chapter 5 and did not change given the various indicators. The official plans of towns/townships, with the largest wetland area in the watershed, 71 % being provincially significant was considered inadequate for these indicators. Integrating knowledge on the distribution and significance of wetlands, the extent

of contributing areas and impacts due to population growth, the policies of upper and lower tier municipalities may be assessed to better support review and changes to certain municipal official plans.

6.1.2 Functional Analysis of the Regions and Counties

Table 6.1 highlights the assessment for the regions and counties. The indicators for the final analysis are listed below the table. Among the regions, with the exception of Halton, regions have totally adequate policies to deal with development adjacent to wetlands. Halton has one of the smallest wetland areas which is mainly regionally or locally significant. It also experienced the lowest population growth. Although, regions have large wetland and contributing areas and showed rapid growth over the given time period, especially in Waterloo region, 3 of the 4 regions had strong and clear statements to protect wetlands. However, counties did not show a similar pattern. In fact, all counties have wetland coverage, but three of the counties do not have an official plan for assessment purposes. Brant, Wellington, Perth, Dufferin and Grey have totally inadequate to inadequate official plan policies based on the indicators. Oxford County was the only county with any strength to protect wetlands through its official plan. As such, regional municipalities tend to have the most up-to-date and strongest wetland protection policies in their official plans.

Table 6.1: Policy Assessment Relative to Indicators in Regions and Counties (1997)

MUN	WET	PRO	REG	CON	POP	DWL	POL	FINAL
Regions								
Halton	12	28	72	7	+2	+0.03	20	A
H-N	26	94	6	2	+11	+0.02	29	TA
H-W	12	81	19	5	+18	+0.02	30	TA
Water	50	72	28	16	+16	+0.10	29	TA
TOTAL	100	74	26	8	+12	+0.04	27	----
County								
Brant	13	76	24	12	+7	+0.03	n/a	TI
Well	49	81	19	20	+17	+0.03	16	IA
Oxford	13	81	19	7	+6	n/c	28	TA
Perth	1	2	98	0	+4	n/c	n/a	IA
Duff	22	38	62	15	+14	n/c	n/a	TI
Grey	2	98	2	1	+18	n/c	9	IA
TOTAL	100	71	29	11	+11	+0.01	18	----

where WET is the wetland area as a percent of the total wetland area
PRO is the Class 1-3 wetland area as a percent of the total wetland area
REG is the Class 4-7 wetland area as a percent of the total wetland area
CON is the contributing area as a percent of the total contributing area
POP is the change in population from 1986-1994
DWL is the change in dwelling density from 1986-1994
POL is the total ranking of the policy assessment
FIN is the final assessment of the municipalities based on all the indicators
TA totally adequate, could incorporate findings of this study
A adequate, review of the plan and findings soon
IA inadequate, needs review of the plan and findings as soon as possible
TI totally inadequate, requires review of the plan immediately
n/c no change
n/a not available
+ increase
- decrease

6.1.3 Functional Analysis of Each Lower-Tier Municipality

As many local municipalities carry out site-level planning, each individual municipality was also assessed against the indicators. Each municipality will be compared by reviewing them in the context of the upper tier municipality. Although Haldimand-Norfolk has a strong regional official plan, the district plans of the Towns of Dunnville and Haldimand could be reviewed. Haldimand-Norfolk experienced the most wetland loss in the watershed in the recent past (Snell, 1987). The majority of wetlands in these municipalities are provincially significant. This should warrant a review of the official plans in terms of wetland protection.

Waterloo has one of the strongest regional plans. However, many of the local official plans do not conform with the regional plan, as the regional plan was recently approved. The official plan of North Dumfries would benefit from a review, as the municipality has one of the largest areas of remaining wetlands in the watershed, the majority which is provincially significant. The township also has a large contributing area and has undergone some population growth over the past few years. Although, Wilmot and Woolwich has a small amount of wetlands, it would be of value for those municipalities to devise stronger wetland protection policies, as so few wetlands remain in these municipalities.

Brant County, without a county plan to guide development, has several local municipalities with official plans that need to be reviewed. Burford with 5.0 % wetland coverage, has 62 % provincially significant wetlands with one of the lowest official plan policy assessments in the county. Brantford and Oakland Township would also benefit from

reviewing their official plans in the context of this study. Brantford Townships' wetlands are small in area, but provincially significant. It is unclear whether there are any wetlands in the First Nations lands, or whether the wetlands have just not been evaluated. The City of Brantford, according to this study, has no wetlands, but one of the strongest official plans for environmental protection. This may be due to strong staff support and guidance on the impacts between activities within the city, on natural systems in and around the city.

Wellington County has one of the largest area of wetlands, yet also has inadequate official plan policies. Several local municipalities, within the county's jurisidiction require immediate review of their plans. Specifically, Erin and Puslinch have the most wetland area in the county which is mainly provincially significant. The Township of Eramosa could review their policies given the large provincially significant wetland area and population growth. It is interesting to note, that Pilkington, Nichol and Peel, with some of the smallest wetland coverage and no change in population, has the strongest wetland protection policies, even within the watershed. Given the total amount of provincially significant wetlands, the large contributing areas, experiencing the largest population growth and having so many local municipalities, Wellington County would benefit in a review of their plan. For the remaining counties, although Oxford County had one of the most effective official plans for wetland protection, the Township of Blandford-Blenheim, with the largest total wetland area in the watershed, has no local municipal plan to guide planning, if done at the local municipal level. At this time, local land use planning is conducted at the county level. If this situation were to change, it would be useful to incorporate strong wetland protection policies at the beginning stages of an official plan. Melancthon in Perth County, also has one

of largest wetland areas and contributing areas with an adequate official plan. Given the wetland coverage and contributing area, this plan should be reviewed. Many of the other municipalities have adequate or official plans which need improvement.

This section provides an analysis and discussion of the policy assessment as reviewed in the context of a watershed approach and an integrative framework to protect wetlands from non-point source pollution. Several benefits were gained from the functional analysis. Firstly, each of the municipal official plans were assessed in the 'bigger picture' to ensure that both the concerns of the municipality and the ecosystem were considered. Secondly, it pointed out areas of concern to the both the Province and the local municipalities in reviewing their official plans. New scientifically based knowledge of the extent and impacts of non-point source pollution was shown to planners and local decision-makers. As well, the variations in the strength at all levels of municipal government was highlighted. In order to effectively protect wetlands, limitations in planning and policies between regions, counties and local municipalities should be noted.

Table 6.2: Policy Assessement Relative to Indicators for the Lower-Tier Municipalities (1997)

Municipality	WET	PRO	REG	CON	POP	DWL	POL	FIN
H-N								
Nanticoke	0.4	25	75	<1	+0.03	+0.02	15	A
Dunnville	4.0	100	0	1	+0.01	+0.02	15	NI
Haldimand	2.2	96	4	2	+0.05	+0.03	14	NI
H-W								
Ancaster	0.2	0	100	<1	+0.31	+0.04	17	A
Flamborough	3.0	87	13	3	+0.08	+0.02	20	A
Glanbrook	<0.1	0	100	0.1	+0.03	+0.01	16	A
HALTON								
Halton Hills	0.3	55	45	<1	+0.22	+0.05	15	A
Milton	2.5	24	76	4	-0.05	+0.02	21	A
WATER								
Cambridge	2.0	96	4	2	+1.65	+0.35	24	A
Kitchener	0.7	100	0	1	+2.18	+0.45	29	TA
Waterloo	0.5	100	0	<1	+4.81	+0.48	9	IA
N. Dumfries	4.7	93	7	7	+0.10	+0.02	18	IA
Wellesley	0.7	79	21	1	---	+0.01	18	A
Wilmot	1.0	21	79	3	+0.07	+0.01	18	NI
Woolwich	2.0	17	83	3	---	+0.01	18	NI
BRANT CO.								
Brantford (C)	0	0	0	0	+0.69	+0.35	25	TA
Paris	0.2	0	100	<0.1	+0.34	+0.13	16	A
Brantford (T)	1.3	94	6	2	---	+0.01	5	TI
Burford	5.0	62	38	5	+0.02	---	13	TI
S. Dumfries	2.0	87	13	3	+0.06	+0.02	23	A
Oakland	2.0	97	3	2	+0.02	---	18	NI

Municipality	WET	PRO	REG	CON	POP	DWL	POL	FIN
BRANT CO.								
Tuscarora	0	0	0	<0.1	n/a	n/a	n/a	A
Onondaga	0	0	0	0	+0.04	+0.01	17	A
WELL								
Guelph (C)	1.0	74	26	1	+2.15	+0.46	18	A
Fergus	<0.1	0	100	<0.1	+2.40	+0.37	23	TA
Erin	8.0	82	18	8	+0.03	+0.01	18	TI
Eramosa	7.4	100	0	10	+0.06	+0.01	25	A
Puslinch	7.0	88	12	8	-0.02	—	11	TI
Peel	1.7	50	50	2	+0.01	+0.01	27	TA
Nichol	1.2	63	37	1	+0.04	+0.01	28	TA
W. Garafraxa	2.6	90	10	4	+0.04	+0.02	21	A
Guelph (T)	2.0	39	61	2	—	—	15	NI
Maryborough	0	0	0	0	+0.01	+0.02	8	A
Arthur (T)	0.4	0	100	<1	+0.01	—	7	IA
Pilkington	0.6	13	87	2	+0.03	—	29	TA
W. Luther	4.2	91	9	2	—	—	18	IA
Elora	0	0	0	0	+0.90	+0.19	3	A
Drayton	0	0	0	0	+2.75	+0.45	11	A
Arthur	0	0	0	0	+0.30	+0.12	3	A
OXFORD								
E. Zorra	0.1	0	100	<1	+0.01	+0.01	n/a	IA
Bland.-Blen.	8.9	87	13	7	+0.01	—	n/a	TI
Norwich	0	0	0	<1	+0.01	+0.01	n/a	IA
PERTH								
Mornington	<0.1	0	100	<1	+0.01	—	13	A
Ellice	<0.1	100	0	<1	+0.01	—	16	A

Municipality	WET	PRO	REG	CON	POP	DWL	POL	FIN
PERTH								
N. Easthope	<0.1	0	100	<1	—	—	24	TA
S. Easthope	<0.1	0	0	0	+0.01	—	12	A
Elma	0.4	0	0	0	+0.01	—	15	A
Wallace	0	0	0	0	+0.02	+0.01	11	A
Milverton	0	0	0	0	+0.58	+0.12	2	A
Amaranth	5.0	41	59	3	+0.02	—	18	NI
E. Luther	2.5	100	0	<1	+0.03	+0.01	17	NI
Melancthon	7.5	0	100	5	—	—	16	TI
E. Garafraxa	2.0	100	0	2	+0.01	—	17	NI
GREY								
Osprey	0	0	0	<1	+0.02	—	16	A
Proton	1.5	98	2	<1	+0.01	—	n/a	TI
Dundalk	0	0	0	0	+1.45	+0.31	16	A

where WET is the wetland area as a percent of the total wetland area
PRO is the Class 1-3 wetland area as a percent of the total wetland area
REG is the Class 4-7 wetland area as a percent of the total wetland area
CON is the contributing area as a percent of the total contributing area
POP is the change in population from 1986-1994
DWL is the change in dwelling density from 1986-1994
POL is the total ranking of the policy assessment
FIN is the final assessment of the municipalities based on all the indicators
n/c no change
n/a not available
< less than
+ increase
- decrease

6.2 Institutional Limitations

Municipal governments in Ontario have been able to implement wetland protection policies since 1984, with the issuance of the wetland planning guidelines. The intent of the

planning reforms was to increase decision- making at the local level within a clear provincial framework (OMNR, 1997). Changes to the *Planning Act*, permitted the municipalities to carry additional powers for local level planning and policy-making. Direction from provincial policy statements provide encouragement and guidance to municipalities to incorporate the principles to protect natural areas, such as wetlands, in the context of their official plans. The policies seek the support of developing "strong communities by considering a coordinated approach when dealing with watershed and ecosystem issues which cross municipal boundaries and to avoid development and land use patterns which might cause environmental concerns" (OMNR, 1997).

Municipal planning is viewed as one of the most important decision-making processes in Ontario in terms of protecting the natural heritage, because it controls future land uses. As previously discussed, planning authorities "shall have regard to" policies issued by the Province, which permits some flexibility for decision-makers to determine the appropriateness of application of a policy. This power allows local policy-makers, the opportunity to implement the protection policies, if so inclined, thus, possibly resulting in the loss of wetlands. Hagan (1994) found that originally, there was little support for wetlands protection at the municipal level, but there has been a gain in support from the municipalities for wetland protection recently. Two issues were accountable for this change. Firstly, there was a concern about the interference wetland policies would have with agriculture. Dry years with declining crop prices lessened the demand for arable land. Secondly, conservation initiatives aimed at soil and water conservation to prevent the contamination of water courses were beneficial. Such initiatives increased the awareness of

the impacts of soil erosion on agricultural productivity, as well as the degradation to watercources and natural areas. Municipalities became more informed about wetland values and the need to protect wetlands (Hagan, 1994).

It is suggested that official plan policies recognize the importance of natural areas and to include a clear municipal goal statement consistent with the intent of the natural heritage policies. Accepted approaches to the identification and evaluation of natural heritage features should be included, as well as statements to guide the demonstration of no negative impacts. However, it is difficult to measure the effectiveness of wetland policies at the municipal level in deterring wetland development issues. Often, there is no way of knowing how many times a planning authority makes a decision to conserve wetlands in the planning process. Issues arise only if development applications are taken to the Ontario Municipal Board. To determine whether municipalities, include wetlands in their review of a development application, staff were asked to rank whether sufficient or insufficient wetland protection was given by their council during deliberations of land-use planning applications. This question was important as it revealed the interest and attitude that staff and councils had when deliberating development applications. Almost all of the respondents stated that their council provided sufficient wetland protection. The remainder of municipalities considered council provided both sufficient and insufficient protection. One respondent indicated that wetlands were not considered during review of planning applications. This suggested that local councils through staff are aware of the issues impacting wetlands with each application.

6.3 Responsibilities

Municipalities were also questioned as to whether they had the resources to effectively protect wetlands. On this issue, respondents commented that regulatory tools and staff expertise made for an effective wetlands protection program at the municipal level. For half of the respondents, the lack of staff time and expertise in reviewing environmental impact statements was a limiting factor. Additional resources through policies and ministerial support would be necessary to properly identify and evaluate wetlands and reviewing EISs for development proposals contiguous to wetlands.

According to the Natural Heritage Training Manual (1997), the responsibility to undertake evaluations of natural heritage areas would be dependent on the municipality. For wetlands, OMNR would be responsible for maintaining and conducting the evaluation system, validating evaluations done by others and determining which wetlands are provincially significant. Training courses for conducting evaluations would be made available to municipalities based on the need. Advice and expertise may be provided from provincial agencies, from time to time, depending on local resources and needs. The municipality may require an IA to demonstrate that no negative impact will occur with the municipalities relying on other agencies to provide advice. OMNR and the CA can review, by arrangement, where resources and needs permit. The municipality will make decisions on development proposals based on impact assessments and considering comments provided by others. Overall, it appears that on this issue, the responses are consistent with the intent of the Province, therefore it can be concluded that if a municipality requires expertise, that support is available through the OMNR and the CA.

6.4 Enforcement of Legislation

Secondly, changes due to Bill 163 were considered to be of little importance. For most municipalities, any changes to their environmental policies were made prior to the CSPS or PPS and reflected the wetland policy statement. Legislative changes may not be included due to the response period of municipalities to review upper-tier or lower-tier official plans. The municipalities, through the comments show a concern or awareness of wetlands when considering any development. For other municipalities, planning staff guide or utilize the provincial policies when discussing development applications with councils. Many municipalities stated that there was a committment to protect provincially significant wetlands. Few comments referred to the protection of other wetlands, whether regionally or locally significant.

6.5 Impacts on Wetlands

Approaches to wetland conservation have focused on establishing provincial priorities through evaluation processes and application of traditional, direct methods such as acquisition or stewardship by landowners. The regulatory approach is indirect, utilizing planning legislation and implementation by planning authorities in a largely proactive land-use planning process. However, the planning process is considered one of the "best vehicles available to use for transfer of information about wetland conservation" as planning authorities across the Province deal with it on a day-to-day basis (Hagan, 1994).

Several municipalities commented on the issue of drainage and the impacts by agriculture on wetlands. The Natural Heritage Policy states it does not constrain existing agricultural uses or prevent the intensification or expansion of agricultural activities, that

presently occur in a natural heritage feature or area, or on adjacent lands where such activities are consistent with the existing zoning, even though such intensification or expansion could result in the destruction of the natural heritage feature (OMNR, 1997). Any changes in use that require approval under the *Planning Act* will be subject to the policy. Exceptions may occur where other legislation applies (e.g. *Endangered Species Act*, *Fisheries Act*). Intensification refers to a change from an existing agricultural activity like grazing to row crop production which is likely to cause a negative impact (e.g. through drainage and land clearing) on the natural heritage feature or area. Expansion of an agricultural activity occurs when an agricultural activity is increased in size into an area where it has not been previously. When a planning body updates their land-use policy documents, it must consider bringing its environmental protection designations and policies in conformity with the PPS. In doing so, a planning authority can apply the more restrictive protection policy, yet still allow legal existing uses to continue. Therefore it is important that further information on the impacts adjacent or within wetlands be provided to local municipalities so that such municipalities are made aware of how decisions on zoning, whether from agricultural activities or development, can prevent destruction of the wetlands.

To effectively protect wetlands, the provincial policies have recommended the use of an environmental impact assessment (IA), to assess the possible impacts that a development may have on a provincially significant wetland. As outlined in the provincial policies since 1992, the environmental impact statement or assessment is the primary means of achieving this objective. It must be demonstrated that there will be no negative impacts on the natural features or ecological functions for which the lands were identified. An

impact statement is the recommended procedure for assessing such impacts. According to the Natural Heritage Manual (1997), the procedures for developing an IA must ensure that they are (a) reasonable and fair; (b) the resulting IAs are only as complex as they need to be; (c) the results of the IA are defensible and repeatable; and (d) are flexible and can be incorporated into other processes. Assessments should identify key functions and processes in a particular area, interactions and the impact of a proposed development. The key objective of the thesis was to provide the basis for a comprehensive impact assessment on non-point source pollution to the wetlands of the Grand River watershed. A functional analysis by integrating this information provides an evaluation of the official plan policies of the municipalities to highlight policies requiring an update based on the status of wetlands and the development pressures impacting non-point source pollution.

6.6 Summary

Southern Ontario's wetlands have been lost due to land use changes for agricultural purposes, urban and industrial growth and recreational development. Although representing only a small portion of the watershed's land coverage, these natural areas perform numerous functions that contribute to the biological productivity and water resource functions. Sustainable development is difficult to attain without wetlands due to their critical role in water quality, quantity and biodiversity. Despite a provincial policy to protect such areas and the functions they perform, wetlands continue to be lost through degradation from non-point source pollution.

During the past three decades, the federal and provincial governments began to recognize and implement wetland protection initiatives. An evaluation system and policy

statements on wetlands and natural heritage features assist the provincial and municipal governments in guiding land-use planning in an environmentally sustainable manner. Although, these policies are in place, degradation of these natural features is ongoing. These policies may be weakened by institutional deficiencies including inadequate funding, a lack of expertise and poorly enforced guidelines. The aim of the thesis was to assess and evaluate the extent of wetlands and the areas contributing non-point source pollution in the Grand River watershed and assessment of the policies directing land-use planning within the watershed's municipalities.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.0 Conclusions

The Province of Ontario aims to protect wetlands through the *Planning Act* by advising decision-makers at the municipal level on the significance of such natural areas. However, to be effective the guidelines on wetland protection contained in the Wetland Policy Statement, the Comprehensive Set of Policy Statements and the recently released Provincial Policy Statements must be accepted and implemented by the municipalities. Within the Grand River watershed, the results of the study indicate both strengths and weaknesses in municipal official plan policies to protect wetlands especially from impacts due to non-point source pollution. Although there is support to protect wetlands, among the respondents to the survey, policies based on the extent and distribution of the wetlands, contributing areas of non-point source pollution and development impacts within the watershed are not necessarily demonstrated within the official plans.

One of the objectives of the study was to determine the status of wetlands in the Grand River watershed. It was found that 7.2 % of the watershed is covered in wetlands, mainly within the counties at the upper-tier municipal level and within the towns/townships at the lower-tier level. Most of the wetlands or 71% are provincially significant. These are found in three-quarters of the watersheds' lower-tier municipalities. Specifically, Dufferin and Wellington counties and the Regional Municipality of Waterloo have the most wetland coverage.

Secondly, through the Lake Erie Non-point Source Model, areas adjacent to the watersheds' wetlands were mapped using landscape and development factors which would

influence the erosion of the sediment and deposition overland to the wetlands. Results determined that 9.5 % of the watershed contributes non-point source pollution directly to the wetlands. The majority of the contribution is found in rural municipalities such as Wellington and Dufferin counties, since the counties and towns/townships have the largest total areas of remaining wetlands; (b) landscape features promoting soil movement; and (c) development activities (agriculture) which influence contamination. Most non-point source pollution was found to be <2 tonnes/hectare/year. However, 1/3 of the contributing is high or greater than 7 tonnes/hectare/ year. Based on the results, generalizations can be made which may be applied to comprehensively guide development of wetland protection policies.

By integrating the information into a policy analysis framework, a value of the wetland protection policies based on an assessment can be determined. It is important to note that the provincial policy statements are intended to guide, allowing individual approaches to be taken by the municipalities, suitable to specific wetlands and provided the goals of the policy statements are fulfilled. Within the watershed, the assessment of the official plans determined that overall, there is a lack of clarity towards wetlands protection. Based on the functional analysis of the wetlands, the contributing areas, development indicators and official plan policy assessment, the official plan policies for the Grand River watershed need improvement.

The primary contribution of this thesis is that it provides scientifically backed research to a policy analysis. Within an integrated framework for policy analysis and by combining normative and evaluative approaches and understanding the impacts due to non-point source pollution should support effective wetland protection policies and planning. .

Dunn (1981) described three approaches to policy analysis; *evaluative, normative* and *empirical*. A contribution of the study is the incorporation of an empirical approach with a normative. With the research, wetland policies can balance environmental, economic and social benefits based on a watershed. This comprehensive can produce policies at both the strategic and operational levels.

The thesis also identifies some institutional limitations which exist to effective wetlands protection. As discussed previously, these impediments include weaknesses at the municipal levels such as inadequate funding, a lack of staff expertise, poorly enforced provincial guidelines and a need for provincial support. Half of the municipalities have policies meeting or more stringent than the provincial policies, however respondents noted that they do not have the resources for effective wetland protection. Such surveys can make important contributions by including staff input to raise awareness on how decisions-making can affect the natural areas. This information helps to enable the Province and municipalities identify weaknesses within municipalities including the acceptibility of provincial policies, need for resources, whether financial or expertise.

Based on these results, recommendations have been made to assist in the effective policy making for wetlands. Generally, wetlands protection through municipal official plans will depend on (a) decision-making from all levels of government based on a comprehensive scientifically based framework (b) support from local level governments for site-level planning using a watershed approach; and (b) acceptable standard guidelines, funding and expertise from the Province.

7.1 Key Findings

Based on the results and discussion, the following key findings were made regarding the wetlands and the policies governing planning in and adjacent to natural areas in the Grand River watershed. Such statements include:

(1) that the adequacy and use of wetland protection policies by municipalities varies throughout the watershed;

(2) that the official plan policies for regional municipalities are more adequate than counties, as several counties within the watershed do not have official plans;

(3) that the official plan policies within towns and townships are inadequate overall, given that 95% of the total area of wetlands and 75% of the provincially significant wetlands are found within towns and townships;

(4) that villages with no wetlands have few to none policies, however, concern since contributions of nonpoint source pollution may be degrading wetlands through field-to-stream transport;

(5) that Wellington County's wetland policies are inadequate based on having the second largest wetland coverage for the watershed, 81 % of which are provincially significant wetlands, the largest contributing area and largest increase in population;

(6) that Dufferin and Brant counties without official plans and having the second and third largest areas of remaining wetlands among counties and that Perth and Grey Counties with small areas of wetlands have inadequate policies;

(7) that Erin and Puslinch Townships in Wellington County; Burford and Brantford Township in Brant County; Blandford-Blenheim in Oxford County; Melancthon in Perth County have totally inadequate policies for the extent of wetlands in their municipalities; and,

(8) that other institutional weaknesses at the municipal level including inadequate funding, a lack of staff expertise, poorly enforced provincial guidelines and a need for provincial support weakens effective protection of wetlands.

7.2 Recommendations

Recommendation 1

The Lake Erie Basin Non-Point Source Model combined with a geographic information system identified the wetlands and contributing areas of non-point source pollution in the Grand River watershed. Many of these areas cross municipal boundaries. It is recommended that:

(1) The Province consider developing a standard official plan review process to update existing out-dated official plans incorporating and measuring the effectiveness of wetland protection policies at a upper- tier and lower- tier level. This process would eliminate the inconsistencies of natural heritage planning from municipality to municipality sharing the same natural heritage system.

(2) All watershed municipalities devise a practical method to target the protection, preservation and enhancement of wetlands. The study could provide a performance indicator as specified in the Provincial Policy Statement to monitor the impacts of urbanization and agricultural activities on wetlands based on their extent, distribution and condition.

Recommendation 2

The protection of wetlands through the Official Plans of the upper- and lower tier municipal governments within the watershed varied in strength. Generally, the official plans with regards to wetland protection needs improvement. Counties and townships with the largest wetland coverages and nonexistent or inadequate policies should be targeted. It is recommended that:

Recognizing the values of wetlands and to guide decision-making, each official plan should have a clear statement, goals and policies with respect to wetland conservation. Specifically, (a) Erin and Puslinch Townships, Wellington County; (b) Burford and Brantford Townships, Brant County; (c) Blandford-Blenheim Township, Oxford County; and (d) Melancthon Township, Perth County have totally inadequate policies and should have a review of official plans soon.

Recommendation 3

Although it is recognized by the Province, that all wetlands, including Class 4-7 or regionally or locally significant wetlands provide important benefits, the Province allows municipalities to make decisions to protect these wetlands. Few lower-tier municipalities include policies to consider the role of locally significant wetlands. These wetlands may or may not be protected under other components of the natural heritage system policies. It is recommended that:

The Province and lower-tier municipalities consider supporting the protection of all wetlands as an important heritage feature in planning documents.

Recommendation 4

The width of high contributing areas in the Grand River watershed demonstrates that impacts may occur from activities at a distance farther than 120 metres within provincially defined adjacent lands. It is recommended that:

The watershed municipalities consider these distances when requiring site specific impact assessments for these priority concern areas. The Province through the ministries of Natural Resources and Agriculture, Food and Rural Affairs could field check the high contributing areas for protection and conservation purposes.

Recommendation 5

Expertise in wetland evaluations and environmental impact assessments were resources requested by many respondents to the municipal staff survey. It is recommended that:

The Ministry of Natural Resources and Grand River Conservation Authority continue to have the mandate and resources to identify, evaluate, enforce and respond to municipalities' inquiries regarding wetland planning issues. Training opportunities be made available to municipal staff in reviewing environmental impact assessments.

Recommendation 6

Insufficient funds for education or stewardship programs, research and a lack of understanding the value of wetlands were considered the issues with the greatest impact to wetland protection. It is recommended that:

The Province provide funds aimed at watershed municipalities with the largest concentration of wetlands and contributing areas to target limited financial support to areas which would receive the most benefit. Funding would be used to develop a programs to build awareness of the value of wetlands by decision-makers, whether councillors or private landowners. Further, that funds be used to initiate or continue wetland rehabilitation/restoration projects or conservation farming programs focused on municipalities with the largest areas of contributing areas.

7.3 Future Research Needs

Firstly, the study focused on only one type of natural area. Significant woodlands, valleylands and areas of endangered species are several other components of the recently released Natural Heritage Policy. A similar research opportunity could locate and identify the impacts to these other components forming a natural heritage system. Integrating the mapping of impacts to these components relative to development pressures would assist in an assessment of the provincial policies or municipal policies.

Secondly, to allow for interpretation of individual properties for site assessment evaluation, the scale of the research could be conducted for each municipality at a 1:10,000 scale. Land-use zoning schedules overlaid with the impact areas might address protection of natural heritage features and areas by dealing on a site-by-site basis and target areas requiring zoning changes in order to effectively protect the natural heritage components. Continual monitoring of the municipalities' needs and review of official plans on a watershed basis, may help to determine local planning limitations. The information could

be used to focus expertise and money to municipalities, with large areas of natural heritage features and areas requiring protection.

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APPENDIX A: LIST OF UPPER- & LOWER-TIER MUNICIPALITIES

Upper-Tier Municipalities

Regional Municipalities

1. Halton
2. Hamilton-Wentworth
3. Haldimand-Norfolk
4. Waterloo

Counties

1. Brant
2. Wellington
3. Oxford
4. Perth
5. Dufferin
6. Grey

Lower-Tier Municipalities

Cities

1. Nanticoke
2. Brantford
3. Cambridge
4. Kitchener
5. Waterloo
6. Guelph

Towns

1. Dunnville
2. Haldimand
3. Ancaster
4. Flamborough
5. Milton
6. Halton Hills
7. Paris
8. Fergus

Townships

1. Elma
2. Glanbrook
3. North Dumfries
4. South Dumfries
5. Wellesley
6. Wilmot
7. Woolwich
8. Brantford
9. Burford
10. Oakland
11. Onondaga
12. Amaranth
13. East Garafraxa
14. West Garafraxa
15. Maryborough
16. Nichol
17. Peel
18. Puslinch
19. East Luther/Grand Valley
20. Melancthon
21. Tuscarora
22. Osprey
23. Proton
24. Blandford-Blenheim
25. East Zorra-Tavistock
26. Ellice
27. Mornington
28. North Easthope
29. South Easthope
30. Arthur
31. Eramosa
32. Erin
33. Guelph
34. Pilkington
35. West Luther
36. Wallace
37. Norwich

Villages

1. Dundalk
2. Milverton
3. Arthur
4. Drayton
5. Elora

APPENDIX B: ATTRIBUTES OF WETLANDS INVENTORY DATABASE

Attributes of ERIEBASI.DBF

WETLANDNUM is the number arbitrarily assigned to each MNRevaluated wetland in the Lake Erie basin. The wetlands are numbered 1 to 546. It is these numbers that identify the wetlands, their contributing areas, and their watersheds on the digitized maps.

MNRMAPNUM is the number assigned to the wetland on the MNR District maps. The numbering system differs with each district so the number would need to be referred to with the district. Not every district had a number, some directly named the wetland on the map.

CLASS is the Wetland Evaluation Class according to the MNR District information. If 2 districts share a wetland and showed different classes, the higher one was used. Note this class sometimes differed from that supplied by the Wildlife Branch lists and available from their computer data base.

MNRNAME is the name assigned to the wetland by MNR. Listed first is the Wildlife Branch version. If the district name is completely different, it follows the Wildlife Branch name with the 2 names separated by a colon (:) and a space. Where no Wildlife Branch listing occurs, the district name was used.

MNRDISTRIC is the MNR District name. When there were 2 or more districts, abbreviations were used by using the first 2 letters eg. Cambridge = Ca; Aylmer = Ay.

POLYGONNUM is the number of digitized wetland polygons with the same wetland name i.e. within the wetland complex that comes under the same WETLANDNUM.

COUNTY is the county within which the wetland occurs. If it extended over more than 1 county, all were listed, separated by commas.

TOWNSHIP is the township within which the wetland occurs. If it extended over more than 1 township, all were listed, separated by commas.

NTSMAP is the National Topographic Series map sheet number (1:50 000 scale) within which the wetland occurs. If it extends over more than 1 map sheet, all were listed, separated by commas.

COMMENTS included notes of any notable variations from the norm. This included referral to problems such as a completely different between the District and Wildlife Branch data; or the qualification of the mapping of the watershed extent if the wetland is on a large river (eg. lower Thames or Grand). The watershed mapped was only the most immediate one, that of the streams and overland flow only not counting that of the large river. It will be available from other data bases supplied by the Inland Waters Directorate.

APPENDIX C: MUNICIPAL STAFF SURVEY

January 1, 1996

Dear Sir/Madam:

Re: Wetland Protection Questionnaire

Wetlands have been widely recognized as providing numerous environmental, economic and social benefits including improvement of water quality, reduction of flood damage and providing habitat for plants and animals. Experiencing the highest population density, wetlands of Southern Ontario have been lost or degraded due to agricultural practices, urban/industrial activities and waste disposal sites. Protection will be dependent on the use and enforcement of laws, regulations and policies at the provincial and municipal government levels.

As a Masters of Environmental Studies student at Wilfrid Laurier University, under the supervision of Dr. Bob Sharpe, I am conducting research to evaluate whether local municipal planning and policy initiatives support effective management of Ministry of Natural Resources evaluated wetlands from non-point sources of pollution in the Grand River watershed. Partially funded by Environment Canada, the project will also complete the spatial mapping database indicating the sensitivity of the contributing wetland watersheds in the Lake Erie basin to non-point source pollution (Snell, 1992).

In the following weeks, if I have not already done so, I will be contacting your office with the hope of reviewing the official plan and zoning by-laws of your municipality. To assist in identifying other issues concerning the protection of these areas, I am enclosing a questionnaire for you to complete or pass on to the most appropriate person. **The information contained within the questionnaire will remain private and confidential.** As approved by the departmental Ethics Review Committee, your name and municipality will not be identified in the report, but will be used for response purposes. The information contained within the questionnaire will be used for statistical purposes and will be kept in a locked drawer during the study. All questionnaires will be shredded at the completion of the project. A summary of the research will be available at your request.

Your participation in completing the questionnaire by January 1, 1996 is appreciated. A stamped self-addressed envelope is enclosed for your convenience. If you have any questions or comments, please do not hesitate to call at (519) 883-9528.

Thank you, in advance, for your participation.

Sincerely,

Marsha L. Paley
Graduate Student

Dr. Bob Sharpe
GIS Director

INFORMATION CONSENT FORM

Respondents' Name _____

Title _____Full or Part time/Years of Planning Experience_____

Municipality _____

According to the Wilfrid Laurier University Senate Policy on Ethics in the Conduct of Research with Human Subjects as adopted May 20, 1976, research must be carried out with the informed and free consent of the respondents. Consent to participate is voluntary. Free consent permits the subjects the right to withdraw consent at any time during the research. Please send the information consent form with the completed questionnaire.

1(a). Has your municipality recently revised its Official Plan?

Yes No

(b). If yes, has the plan been approved by Council? Date?
If no, when is the plan expected to be reviewed? (i.e. within 5 years)

(c). If yes, has the plan been approved by the Ministry of Municipal Affairs? Date?
If no, when is the plan expected to be approved?

2(a). Would you like a summary of the research?

Yes No

Wetland Protection Questionnaire

1(a). Which level of municipal government do you represent? Circle appropriate category.

Region County Local Municipality

2(a). Does municipal staff plan for land use within your municipality? If no, state below the level of municipal government, planning consultant or other agency which conducts the land use planning for your municipality and **return the questionnaire in the enclosed envelope**. *If yes, please answer questions 3-11.*

If no, _____

3(a). Circle the agency(ies) your municipality might seek(s) for information regarding protection of wetlands or planning adjacent to wetlands. If more than one agency, in the parentheses, state the order of contact (1-first agency you call, 2-second agency etc.) **(b).** In the squares, rank the agency(ies) in your municipality in their strength to protect wetlands (1-strongest, 7-weakest).

Order of Contact		*Strength*
	a. Province	
( )	i. Ministry of Natural Resources	[ ]
( )	ii. Ministry of Municipal Affairs	[ ]
( )	iii. Ministry of Agriculture, Food & Rural Affairs	[ ]
	b. Municipality	
( )	i. Region	[ ]
( )	ii. County	[ ]
( )	iii. Local	[ ]
( )	c. Conservation Authority	[ ]

4(a). State the relative importance of environmental issues, including wetland protection, in land use planning in your municipality as compared to the following (i.e. 1-most important, 3-least important).

___ Environmental Planning (incl. wetlands)
___ Economy/Development (incl. agriculture, mineral extraction, home/businesses)
___ Community/Public Services

5(a). Is sufficient or insufficient wetland protection given by your Council during deliberations of land use planning applications? Circle appropriate category. **(b).** If 1 or 2 is circled, state possible reasons.

Insufficient Sufficient

1 2 3 4 5

6(a). Rank the following issues for having the smallest to the largest impact on effective wetland protection (1-issue with smallest impact, 6-issue with largest impact).

( ) lack of provincial direction
( ) too many agencies dealing with wetlands
( ) disinterested landowners/lack of understanding value of wetlands
( ) insufficient funds for education or stewardship programs/research
( ) weak or ambiguous municipal policies or by-laws
( ) limited municipal staff/council expertise

7(a). Overall, do you believe your municipality has the resources (policies, staff or financial) to effectively protect wetlands? **(b).** If yes, please explain? If no, what would be beneficial?

Yes No

_____ _____

_____ _____

8(a). Does your municipality have an Environmental and Ecological Advisory Committee for Land use planning?

Yes No

9(a). Would a landowner stewardship program available through the municipalities be beneficial for wetland protection? Circle choice. **(b).** Does your municipality have the resources (staff and finances) to support a landowner stewardship program? Check mark your choice.

Yes No

10(a). Has Bill 163 had any influence on wetland protection in your municipalitys' decision making? If yes, what general changes to the official plan/zoning by-laws have been made? If no, why not? **(b).** If the phrase 'be consistent with' is changed to 'have regards to' in Bill 163, could this affect your municipality's wetland protection? If yes, why and how? If no, why not?

(a). Yes No

_____ _____

_____ _____

_____ _____

(b). Yes No

_____ _____

_____ _____

_____ _____

11(a). Rank the following general zoning approaches your municipality might use to plan sensitive contributing areas adjacent to wetlands (1-most willing to use, 4-least willing to use).

___ no development permitted within setback determined by Province
___ restricted development (any development permitted within setback only if Environmental Impact Statement requirements satisfied)
___ limited development (buffered agricultural zone, related structures or residential outside of setback)
___ conditional development (buffered agricultural zone, related structures or residential within setback if Environmental Impact Statement requirements satisfied)
___ no change to present municipal policies

**** For further comments, please attach 'reused' paper. Your contribution to the research is appreciated. Thank you.***

APPENDIX D: OFFICIAL PLAN REVIEW QUESTIONS

Official Plan Review Questions

1. On a scale of 1 to 5, does the municipality incorporate the policies in the OWPS, the CSPS or the PPS as it relates to protection of wetlands.

2. On a scale of 1 to 5, does the official plan conform with the OWPS, the CSPS or the PPS in prohibiting development within provincially significant wetlands?

3. On a scale of 1 to 5, does the official plan conform with the OWPS, the CSPS or the PPS in permitting development on adjacent lands (land within 120 metres of an individual wetland or all lands connecting individual wetlands within a wetland complex?

4. On a scale of 1 to 5, does the official plan refer to the use of an Environmental Impact Study or Assessment to demonstrate:

   (a) no net loss of wetland functions;
   (b) create subsequent demand for future development which will negatively impact on existing wetland functions;
   (c) conflict with existing site specific wetland management practices; and,
   (d) result in a loss of contiguous wetland area.

5. On a scale of 1 to 5, has additional methods of protection to wetlands been provided?

6. On a scale of 1 to 5, has another agency referred to or their regulations been incorporated to provide additional support through another agency?

APPENDIX E: FIGURES 4.0, 4.1 AND 4.2

The following figures are found in the envelope at the end of the Appendices.

APPENDIX F: STUDY AML PROGRAM

DELIVERY.AML

```
/* delivery.aml
/*
/* THE GRAND RIVER WATERSHED:
/* Non-Point Source Pollution Contributed Overland
/* to Provincially Evaluated Wetlands
/*
/*-------------------------------------------------------------------------
&severity &error &routine bailout

&args name cover

&type \\RUNNING DELIVERY MAPPING PROGRAM\\

&type \\AREA OF DELIVERY MAPPING: %cover%\\
&if [exist %name% -directory] &then
        &do
                killmap %name%
                &type \*Old map composition called %name% is being replaced \\
        &end
&if [exist %name%map.gra -file] &then
        &do
                &system rm %name%map.gra
                &type \*Old graphics file called %name%map.gra is being replaced \\
        &end
&if [exist %name%map.hpgl2 -file] &then
        &do
                &system rm %name%map.hpgl2
                &type \*Old postscript file called %name%map.hpgl2 is being replaced \
        &end
&type \ *The map composition now being created will be called %name% \\

display 9999 3 position ur screen
map %name%
/* MAP LINEWORK
mapextent arc %cover%
pagesize 32 42
linesymbol 1
box 1 1 30.5 41.5
linesymbol 9
box 1.2 1.2 30.3 41.3
```

```
/* MAP PARAMETERS
mapunits metres
maplimits 2 2 29.7 39
clipmapextent off
mapposition cen cen
mapscale 220000

/* MAP TITLE
textfont 94021
textquality kern
textsize 32 pt
move 16 40.7
text "FIGURE 4.0: NON-POINT SOURCE POLLUTION CONTRIBUTED" cc
textsize 32 pt
move 16 40.2
text "OVERLAND TO PROVINCIALLY EVALUATED WETLANDS" cc
text 32 pt
move 16 39.7
text "IN THE GRAND RIVER WATERSHED" cc

/* MAPPING DELIVERY CLASSES
&type \Shading Non-point Source Pollution Delivery Classes \

shadeset delivery.shd
lineset plotter
linesymbol 1

dropline %cover% classy notext

reselect %cover% polys classy eq 1 /* High
        polygonshades %cover% 1
clearsel
reselect %cover% polys classy eq 2 /* Moderate
        polygonshades %cover% 2
clearsel
reselect %cover% polys classy eq 3 /* Low
        polygonshades %cover% 3
clearsel

&type \Shading Other Land use Classes\

reselect %cover% polys classy eq 30 /* Built-Up Areas
        polygonshades %cover% 6
```

```
clearsel
reselect %cover% polys classy eq 31 /* Extraction Areas
        polygonshades %cover% 7
clearsel
reselect %cover% polys classy eq 32 /* Water
        polygonshades %cover% 5
clearsel
reselect %cover% polys classy eq 33 /* Unclassified
        polygonshades %cover% 94
clearsel
reselect %cover% polys classy eq 35 /* Wetland
        polygonshades %cover% 4
clearsel

/* PLOTTING BACKGROUND COVERAGES
lineset colour
shadeset colour
arclines townshiptr 1
polygonshades lakestr 5
arclines riverstr 5
arclines shorelinetr 5
arclines roads 14

/* CREATING LEGEND
shadeset delivery.shd
lineset plotter.lin
linesymbol 1

patch 21.4 39.7 29.8 26.9
box 21.4 39.7 29.8 26.9

textsize 32 pt
move 22 39.2
text "LEGEND" cl
textsize 26 pt
move 22 38.5
text "Non-Point Source Pollution Delivery Classes" cl
keyposition 22 38
keybox 1 .3
keysep .3 .15
textsize 22 pt
keyshade delivery.key
```

```
textsize 30 pt
move 22 28
text "SCALE 1:220000" cl

textsize 26 pt
move 22 36.3
text "Hydrology" cl
move 22 34.5
text "Other Land use Classes" cl
textsize 22 pt
keyposition 22 35.7
keyshade landuse1.key
keyposition 22 34
keyshade landuse2.key
shadeset colornames
keyposition 22 33
keyshade unclass.key
lineset colour
keyposition 22 32.5
keybox 1 .3
keysep .3 .15
keyline roads.key nobox

textsize 24 pt
move 22 31
text 'Notes: This map illustrates the use of GIS for'
move 22 30.7
text 'integrating data from various sources to determine'
move 22 30.4
text 'the overland contribution of non-point source'
move 22 30.1
text 'pollution to provincially evaluated wetlands.' cl
move 22 29.5
text 'Source: Paley, M. L. 1997. Protection of Wetlands ' cl
move 23.3 29.2
text 'from Non-point Source Pollution' cl
move 23.3 28.9
text 'in the Grand River Watershed
move 23.3 26.9
text 'A Masters Thesis' cl

textsize 20 pt
move 22 27.3
```

```
text "Date: December 1997" cl

markerset north.mrk
markersymbol 9
markersize 2
marker 28 28

patch 1.8 39.4 11.5 25.8
box 1.8 39.4 11.5 25.8
maplimits 2.2 38.6 10.9 26
mapscale automatic
mapextent watershed
textsize 26 pt
move 3.3 38.8
text "Figure: 4.1: CENSUS SUBDIVISION NAMES"
arclines townshiper 1
textsize 11 pt
items townshiper poly
polygontext townshiper name
patch 1.9 12.9 9.7 1.9
box 1.9 12.9 9.7 1.9

shadeset delivery.shd

linetype wide
linesize 0.75
linecolor [unquote[show shadecolor 1 1 ]]
lineput 1
linetype wide
linesize 0.75
linecolor [unquote[show shadecolor 2 1 ]]
lineput 2
linetype wide
linesize 0.75
linecolor [unquote[show shadecolor 3 1 ]]
lineput 3
linetype wide
linesize 0.75
linecolor [unquote[show shadecolor 6 1 ]]
lineput 30
linetype wide
linesize 0.75
linecolor [unquote[show shadecolor 7 1 ]]
```

```
lineput 31
linetype wide
linesize 0.75
linecolor [unquote[show shadecolor 5 1 ]]
lineput 35
linetype wide
linesize 0.75
linecolor [unquote[show shadecolor 94 1 ]]
lineput 33
linetype hardware
linesize 0
linecolor 1
graphextent 0 0 8 550
move 3.2 12.4
textsize 16 pt
text "FIGURE 4.2: HISTOGRAM OF TOTAL AREA BY DELIVERY"
move 3.2 12.6
text "AND LAND-USE CLASS" cc
graphlimits 2.6 2.5 9.28 12
units graph
graphbar totarea info num
sum-area classy # # xsort
axis horizontal
textsize 12 pt
/*axishatch 1
/*axislabels 1 0 0 0.2
textjustification ul
textoffset -0.5 0
axistext "Classification" center
axis vertical
axishatch 100
axislabels 100 0
textjustification cr
textoffset -0.6 0
textdirection vertical
textangle 270
textquality constant
axistext "Total Area '000 sq. kms" center

&pause

&s .plot [response 'Do you want to plot it? (y or n)']
        &if %.plot% = 'y' &then
```

```
            &do
                    &r delivery %name%map
                    display 1040
                    %name%map
                    plot %name%
                    q
        rotateplot %name%map.gra %name%mapr.gra
        hpgl2 %name%mapr.gra %name%map.hpgl2 650c # ~
                    opaque # # # # # # ps
        lpr -Php650c %name%map.hpgl2
            &end
&call exit
&return
/*----------------------------------ROUTINE USAGE-------------------------

/*
&routine usage
&type USAGE: &run delivery.aml <name> <cover>
&return
/*
 *----------------------------------ROUTINE EXIT--------------------------
/*
&routine exit
&return
 *
/*----------------------------------ROUTINE BAILOUT-----------------------
/*
&routine bailout
&severity &error &ignore
&call exit
&return: &return &error BAILING OUT OF delivery.aml
/*
 * END OF DELIVERY.AML-------------------------------------------------------
```

APPENDIX G: MUNICIPAL AREA DIFFERENCES USING A GIS

Municipal Area Differences Using a Geographic Information System

Municipality	Census Area (ha)	GIS Area (ha)	Area Difference	% Change
Wilmot	26205	26619.3	-414.3	-1.6
East Zorra	24505	25060.5	-555.5	-2.2
Cambridge	11564	11537.1	26.9	0.2
North Dumfries	18454	19110.4	-656.4	-3.4
Puslinch	23108	18265.02	4843.0	26.5
Norwich	43395	43532	-137.0	-0.3
Ancaster	17455	17717.79	-262.8	-1.5
Glanbrook	20274	20512.6	-238.6	-1.2
Brantford	23960	23910.6	49.4	0.2
City of Brantford	7123	7361.5	-238.5	-3.2
Paris	1364	1509.86	-145.9	-9.7
Oakland	4543	4632.19	-89.2	-1.93
Tuscarora	n/a	n/a	n/a	n/a
Onondaga	8711	8899.83	-188.8	-2.1
Nanticoke	67472	94210.33	-26738.3	-28.4
Haldimand	63815	83612.14	-19797.1	-23.7
Dunnville	30292	54911.4	-24619.4	-44.8
Elora	351	335	16	4.8
Fergus	723	719.29	3.71	0.5
Drayton	186	232.2	-46.2	-19.9
Dundalk	187	196.3	-9.3	-4.7
Milverton	178	210.6	-32.6	-15.5
Mornington	20451	20791.3	-340.3	-1.6
Wellesley	27402	29841.1	-439.1	-1.6
Guelph	11804	11920.2	-116.22	-1.0

Municipality	Census Area (ha)	GIS Area (ha)	Area Difference	% Change
City of Guelph	6872	6956.6	-84.6	-1.2
Halton Hills	27586	27815.3	-229.3	-0.1
Elma	27379	27797.3	-418.3	-1.5
Ellice	22699	23112.4	-413.4	-1.8
North Easthope	17695	17900.3	-205.3	-1.2
South Easthope	9755	9888.9	-133.9	-1.4
Melancthon	31239	31393.7	-154.7	-0.5
Proton	33754	33789.7	-35.7	-0.1
Arthur	27001	27226.9	-225.9	-0.8
Village of Arthur	392	426.1	-34.1	-8.0
West Luther	20602	20844.5	-242.5	-1.2
East Luther	16213	16232.3	-19.3	-0.1
Amaranth	26532	26616.2	-84.23	-0.3
Wallace	20508	20970.1	-462.1	-2.2
Maryborough	23094	23383.7	-289.7	-1.2
Nichol	10831	10445.2	385.8	3.69
Pilkington	12341	12161.2	179.8	1.5
East Garafraxa	16513	16699.0	-186.0	-1.1
Erin	29416	29500	84.0	-0.3
Osprey	29409	29635.8	-226.8	-0.8
Eramosa	18865	18902.5	-37.5	-0.2
West Garafraxa	18935	19680.5	-745.5	-3.8
Peel	30441	31175.1	-734.1	-2.4
Woolwich	32388	32939.5	-551.5	-1.7
Burford	27639	27822.7	-183.7	-0.7
Flamborough	48990	49574.2	-584.2	-1.2
South Dumfries	18193	18645.1	-452.1	-2.4

Municipality	Census Area (ha)	GIS Area (ha)	Area Difference	% Change
Blandford-Blenheim	39539	39978.3	-439.3	-1.1
Kitchener	13515	13872.5	-357.5	-2.57
Waterloo	6443	6475.8	32.8	-0.5
Milton	36720	36889	169	5.9
TOTAL	1155021	708750.4	-36667.4	-5.5

APPENDIX H: TOTAL WETLAND AREA BY PERCENT AREA OF MUNICIPALITY WITHIN WATERSHED

Total Wetland Area by Percent Total Area of Lower Tier Municipality (1997)

Municipality	Ha	%(wi)	% (all)	Municipality	Ha	% (wi)	% (all)
Bland.-Blen.	4152.5	11.8	10.4	Wellesley	352.1	1.3	1.3
Erin	3799.2	22.9	12.9	Kitchener	333.2	2.4	2.4
Melancthon	3511.9	19.3	11.2	Pilkington	304.8	2.5	2.5
Eramosa	3474.1	18.4	18.4	Waterloo	227.2	3.5	3.5
Puslinch	3416.6	18.7	18.7	N. Easthope	204.9	2.1	1.1
Amaranth	2397.6	10.8	9.0	Arthur (T)	193.4	0.7	0.0
N. Dumfries	2206.1	11.5	11.5	Nanticoke	186.1	1.8	0.2
Burford	2203.0	15.4	7.9	Halton Hills	152.8	18.2	0.5
W. Luther	1992.9	12.5	9.5	Ancaster	72.1	0.6	0.4
Dunnville	1638.4	10.7	2.9	Paris	71.2	4.7	4.7
Flamborough	1264.9	7.5	2.6	East Zorra	56.2	2.2	2.2
W. Garafraxa	1254.5	6.4	6.4	Glanbrook	16.7	2.6	0.1
Milton	1169.6	19.6	3.2	Mornington	11.6	7.2	0.1
E. Luther	1153.9	7.2	7.2	Ellice	5.1	0.6	0.0
Haldimand	1024.0	2.8	1.2	Fergus	0.9	0.1	0.0
Woolwich	977.4	3.0	3.0	Osprey	n/a	n/a	n/a
S. Dumfries	972.8	5.2	5.2	Brantford (C)	n/a	n/a	n/a
Cambridge	929.9	8.1	8.1	Tuscarora	n/a	n/a	n/a
Guelph (T)	900.5	7.5	7.5	Onondaga	n/a	n/a	n/a
E. Garafraxa	896.8	6.2	5.4	Elora	n/a	n/a	n/a
Peel	829.1	2.7	2.7	Drayton	n/a	n/a	n/a
Oakland	800.8	17.5	17.3	Dundalk	n/a	n/a	n/a
Proton	707.9	18.9	2.1	Milverton	n/a	n/a	n/a
Brantford (T)	624.1	2.6	2.6	Elma	n/a	n/a	n/a
Wilmot	576.8	2.2	2.2	S. Easthope	n/a	n/a	n/a
Nichol	575.8	5.5	5.5	Arthur (V)	n/a	n/a	n/a
Guelph (C)	465.4	6.7	6.7	Wallace	n/a	n/a	n/a
Norwich	429.4	7.5	1.0	Maryborough	n/a	n/a	n/a

APPENDIX I: TOTAL WETLAND AREA BY CLASS FOR LOWER-TIER MUNICIPALITIES

Wetland Area by Class as a Percent of the Total Wetland Area for Lower-Tier Muncipalities (1997)

Municipality	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
Wilmot	21 %	0	0	52	25	2	0
East Zorra	0	0	0	0	0	0	100
Cambridge	73	23	0	0	0	0	4
North Dumfries	68	10	16	0	1	6	0
Puslinch	84	4	0	4	4	5	0
Norwich	0	0	0	0	0	0	0
Ancaster	0	0	0	0	16	84	0
Glanbrook	0	0	0	0	0	0	100
Brantford (T)	94	0	0	6	0	0	0
Brantford (C)	0	0	0	0	0	0	0
Paris	0	0	0	100	0	0	0
Oakland	97	0	0	0	3	0	0
Tuscarora	0	0	0	0	0	0	0
Onondaga	0	0	0	0	0	0	0
Nanticoke	0	0	25	0	0	54	21
Haldimand	57	17	20	0	0	0	3
Dunnville	50	45	4	0	0	0	0
Elora	0	0	0	0	0	0	0
Fergus	0	0	0	0	100	0	0
Drayton	0	0	0	0	0	0	0
Dundalk	0	0	0	0	0	0	0
Milverton	0	0	0	0	0	0	0
Mornington	0	0	0	0	0	100	0
Wellesley	79	0	0	21	0	0	0
Guelph (T)	19	20	0	45	21	0	0

Municipality	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
City of Guelph	19 %	0	53	0	26	0	0
Halton Hills	55	0	0	0	0	0	45
Elma	0	0	0	0	0	0	0
Ellice	0	100	0	0	0	0	0
North Easthope	0	0	0	46	0	54	0
South Easthope	0	0	0	0	0	0	0
Melancthon	0	0	0	0	16	59	25
Proton	0	0	98	0	0	1	1
Arthur	0	0	0	46	0	54	0
Village of Arthur	0	0	0	0	0	0	0
West Luther	91	0	0	0	9	0	0
East Luther	100	0	0	0	0	0	0
Amaranth	24	17	0	25	15	16	4
Wallace	0	0	0	0	0	0	0
Maryborough	0	0	0	0	0	0	0
Nichol	63	0	0	0	37	0	0
Pilkington	13	0	0	52	35	0	0
East Garafraxa	1	35	67	0	0	0	0
Erin	82	0	0	0	18	0	0
Osprey	0	0	0	0	0	0	0
Eramosa	99	1	0	0	0	0	0
West Garafraxa	62	27	0	0	10	0	0
Peel	50	0	0	0	36	2	12
Woolwich	17	0	0	0	64	19	0
Burford	40	0	22	0	20	11	8
Flamborough	87	0	0	13	0	0	0
South Dumfries	87	0	0	7	0	7	0

Municipality	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
Blandford-Blenheim	72	14	<1	8	2	1	2
Kitchener	100	0	0	0	0	0	0
Waterloo	100	0	0	0	0	0	0
Milton	24	0	0	30	41	0	4

APPENDIX J: GRAND RIVER WETLANDS INVENTORY

Grand River Watershed Wetlands Information (Adaptedfrom the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
1.	22	7	BC7	Simcoe	1	Brant	Burford	40P/1
2.	24	3	W7B	Simcoe	1	Brant	Burford	40P/1
3.	25	7	BC20	Simcoe	4	Brant	Burford	40P/1
4.	26	1	KC	Simcoe	29	Brant, Oxford	Burford, Norwich	40P/1, 40P/2
5.	251	3	BO6	Simcoe	1	H-N	Nanticoke	40I/16
6.	252	6	BO3	Simcoe	1	H-N	Nanticoke	40I/16
7.	265	6	BO4	Simcoe	1	H-N	Nanticoke	40I/16
8.	266	7	NC11	Simcoe	1	H-N	Nanticoke	40I/16
9.	267	7	BO5	Simcoe	1	H-N	Nanticoke	40I/16
10.	268	3	NC12	Simcoe	2	H-N	Nanticoke	40I/16, 40P/1
11.	277	2	Dry Lake	Niagara	1	H-N	Haldimand	30L/13
12.	278	2	Taquanya C.A.	Niagara	2	H-N	Haldimand	30L/13
13.	279	3	Clanbrassil Woodlot	Niagara	1	H-N	Haldimand	30L/13
14.	280	1	Young Tract	Niagara	29	H-N	Haldimand	30L/13, 30M/4
15.	281	1	Grand River Marshes	Niagara	3	H-N	Haldimand	30L/13
16.	282	1	Grand River Marshes	Niagara	1	H-N	Haldimand	30L/13
17.	283	1	Grand River Marshes	Niagara	3	H-N	Haldimand	30L/13

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
18.	284	1	Grand River Marshes	Niagara	3	H-N	Haldimand	30L/13
19.	285	1	Grand River Marshes	Niagara	2	H-N	Haldimand, Dunnville	30L/13
20.	286	1	Grand River Marshes	Niagara	2	H-N	Dunnville	30L/13
21.	287	1	Grand River Marshes	Niagara	1	H-N	Dunnville	30L/13
22.	288	1	Grand River Marshes	Niagara	1	H-N	Dunnville	30L/13
23.	289	1	Grand River Marshes	Niagara	6	H-N	Dunnville	30L/13
24.	290	1	Grand River Marshes	Niagara	2	H-N	Dunnville	30L/13
25.	291	1	Dunnville Marshes	Niagara	1	H-N	Dunnville	30L/13
26.	292	1	Dunnville Marshes	Niagara	2	H-N	Dunnville	30L/13
27.	293	1	Dunnville Marshes	Niagara	1	H-N	Dunnville	30L/13
28.	294	1	Dunnville Marshes	Niagara	1	H-N	Dunnville	30L/13
29.	295	1	Dunnville Marshes	Niagara	1	H-N	Dunnville	30L/13
30.	296	3	Fradenburg Tract	Niagara	2	H-N	Haldimand	30L/13
31.	297	2	James North Allan Park	Niagara	3	H-N	Dunnville	30L/13

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
32.	298	3	Clements Tract	Niagara	2	H-N	Dunnville	30L/13
33.	299	2	Dunnville Woodlots	Niagara	3	H-N	Dunnville	30L/13
34.	300	2	East of Dunnville Woodlots	Niagara	17	H-N	Dunnville	30L/13
35.	301	3	Enco Wetland	Niagara	1	H-N	Dunnville	30L/13
36.	302	2	Old Welland Feeder Canal	Niagara	1	H-N	Dunnville	30L/13
37.	303	3	Nelles Tract Woodlots	Niagara	3	H-N	Haldimand	30M/4
38.	304	7	Roger's Creek Trib.	Niagara	1	H-N	Haldimand	30M/4
39.	305	7	Boston-McKenzie Creeks	Niagara	1	H-N	Haldimand	30M/4
40.	306	6	Boston Creek #2	Niagara	2	H-N	Haldimand	30M/4
41.	307	6	BO2	Simcoe	1	H-N	Nanticoke	40P/1
42.	308	7	MC1	Simcoe	1	H-N	Nanticoke	40P/1
43.	309	7	MC2	Simcoe	1	H-N	Nanticoke	40P/1
44.	310	6	BO1	Simcoe	1	H-N	Nanticoke	40P/1
45.	311	1	Lower Oakland Swamp	Simcoe	8	Brant, H-N	Oakland, Nanticoke	40P/1
46.	312	5	East Oakland Swamp	Simcoe, Cambridge	6	Brant	Oakland, Brantford	40P/1
47.	313	1	Oakland Swamp	Simcoe, Cambridge	3	Brant	Oakland, Brantford	40P/1

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
48.	314	6	Dunmark Lake-Currans Swamp	Cambridge	3	H-W	Ancaster	40P/1
49.	315	5	Copetown Bog	Cambridge	1	H-W	Ancaster	40P/1
50.	316	1	Fairchild Creek Complex	Cambridge	19	Brant, H-W	Brantford, South Dumfries, Flambo-rough	40P/1
51.	317	4	Harrisburg East Swamp	Cambridge	6	Brant, H-W	South Dumfries, Flambo-rough	40P/1
52.	318	4	Troy Swamp	Cambridge	8	H-W	Flambo-rough	40P/1, 40P/8
53.	319	6	Blue Lake Wetland	Cambridge	2	Brant	South Dumfries	40P/1
54.	320	1	Glen Morris Ridge Wetland Complex	Cambridge	134	Brant, Waterloo	South & North Dumfries	40P/1, 40P/8
55.	321	1	Spottis-wood/Pine-hurst Lake	Cambridge	20	Brant, Waterloo	South & North Dumfries	40P/1, 40P/8
56.	322	1	Turnbull Lake/ Charlie Crk.	Cambridge	2	Brant, Waterloo	South Dumfries	40P/1, 40P/8
57.	323	6	Prothono-tary Pond	Cambridge	1	Brant	South Dumfries	40P/1
58.	324	4	West Paris River Swamp	Cambridge	2	Brant	Burford	40P/1
59.	325	7	W7A	Simcoe	1	Brant	Burford	40P/1
60.	327	7	W7C	Simcoe	1	Brant	Burford	40P/1

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
61.	328	1	Whitemans Crk.	Simcoe	12	Brant	Burford	40P/1
62.	329	5	W1B	Simcoe	2	Brant	Burford	40P/1
63.	330	1	W1A	Simcoe	6	Brant	Burford, Brantford	40P/1
64.	331	7	W2A	Simcoe	2	Brant	Burford	40P/1
65.	332	7	W4A	Simcoe	2	Brant	Burford	40P/1
66.	333	6	W4B	Simcoe	6	Brant	Burford	40P/1
67.	334	3	M1A	Simcoe	7	Brant	Burford	40P/1, 40P/2
68.	335	6	Canning Swamp	Cambridge	5	Oxford	Blandford-Blenheim	40P/1, 40P/2
69.	336	5	K6A	Simcoe	8	Brant, Oxford	Burford, Norwich	40P/2
70.	337	5	W6A	Simcoe	6	Oxford	Burford	40P/2
71.	338	3	K1A	Simcoe	21	Brant, Oxford	Burford, Norwich	40P/2
72.	339	7	K2A	Simcoe	9	Brant, Oxford	Burford, Norwich	40P/2
73.	340	7	K3B	Simcoe	1	Brant	Burford	40P/2
74.	341	7	K1B	Simcoe	5	Brant	Burford	40P/2
75.	342	1	Central Whiteman's-Horner Creek	Simcoe, Cambridge, Aylmer	64	Brant, Oxford	Burford, Blandford-Blenheim	40P/2, 40P/7
76.	343	7	NR2	Simcoe	2	Oxford	Burford	40P/2
77.	344	2	Benwell Swamp	Cambridge	4	Oxford	Blandford-Blenheim	40P/2
78.	345	4	Burgess Lake Swamp	Cambridge	3	Oxford	Blandford-Blenheim	40P/2

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
79.	346	1	Black River Swamp	Cambridge	2	Oxford	Blandford-Blenheim	40P/2, 40P/7
80.	347	7	Drumbo Swamp	Cambridge	12	Oxford	Blandford-Blenheim	40P/2
81.	348	7	K5B	Simcoe	3	Oxford	Norwich	40P/2
82.	349	6	K5A	Simcoe	6	Oxford	Norwich	40P/2
83.	352	6	Eastwood Wetland Complex	Simcoe	9	Oxford	Blandford-Blenheim, Norwich	40P/2
84.	361	1	Vansittart Woods	Aylmer	1	Oxford	Blandford-Blenheim	40P/2
85.	363	2	Golspie Swamp	Aylmer	7	Oxford	Zorra	40P/2
86.	374	7	K3A	Simcoe	3	Oxford	Norwich	40P/2
87.	377	1	Sheffield-Rockton Wetland Complex	Cambridge	97	H-W, Brant	Flambo-rough, Cambridge, North Dumfries	40P/8
88.	378	1	Beverly Swamp	Cambridge	1	H-W, Waterloo	Flambo-rough, North Dumfries	40P/8
89.	379	1	Valens Reservoir & Swamp	Cambridge	7	H-W	Flambo-rough	40P/8
90.	380	6	Clyde Bog	Cambridge	1	Waterloo	North Dumfries	40P/8
91.	381	1	Glen Morris Valley Wetland	Cambridge	13	Brant, Waterloo	S. & N. Dumfries	40P/8
92.	382	2	Branchton Swamp	Cambridge	1	Waterloo	North Dumfries	40P/8
93.	383	6	Oliver's Bog	Cambridge	8	Waterloo	North Dumfries	40P/8

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
94.	384	1	Moffat Crk. Swamp	Cambridge	6	Waterloo	North Dumfries, Cambridge	40P/8
95.	385	6	Deans Lake-Cowan's Lake	Cambridge	3	Waterloo	North Dumfries	40P/8
96.	386	3	Galt Ridge/ Sudden Bog	Cambridge	8	Waterloo	North Dumfries	40P/8
97.	387	3	Taylor's Lake/ Beake Pond	Cambridge	3	Waterloo	North Dumfries	40P/8
98.	388	5	Milroy Lake	Cambridge	4	Waterloo	North Dumfries	40P/8
99.	389	2	Salisburg-Gilholm Complex	Cambridge	3	Waterloo	North Dumfries	40P/8
100.	390	1	Barrie's Lake Wetland	Cambridge	5	Waterloo	North Dumfries	40P/8
101.	391	3	Orrs Lake/ Altrieve Lake Wetland	Cambridge	2	Waterloo	North Dumfries	40P/8
102.	392	1	Roseville Swamp/ Cedar Crk.	Cambridge	4	Waterloo	North Dumfries	40P/8
103.	393	2	Grass Lake/ Paris Cranberry Bog	Cambridge	2	Waterloo	North Dumfries	40P/8
104.	395	1	Bannister & Wrigley Lakes	Cambridge	3	Waterloo	North Dumfries	40P/8
105.	396	6	Drynan Tract	Cambridge	13	Waterloo	North Dumfries	40P/8

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
106.	397	3	Little Turnbull Lake	Cambridge	2	Waterloo	North Dumfries	40P/8
107.	398	3	Greenfield Swamp	Cambridge	6	Waterloo	North Dumfries	40P/8
108.	399	1	Strasburg Creek Wetland	Cambridge	9	Waterloo	Kitchener-Waterloo0	40P/8
109.	400	2	Blair Creek Wetland	Cambridge	6	Waterloo	Cambridge, North Dumfries	40P/8
110.	401	1	Speed River Wetland	Cambridge	6	Waterloo	Cambridge, Puslinch, Guelph	40P/8, 40P/9
111.	402	7	Kossuth Bog	Cambridge	1	Waterloo	Cambridge	40P/8
112	403	1	Lower Ellis Creek Wetland	Cambridge	5	Waterloo	Cambridge, Woolwich	40P/8
113.	404	5	Breslau Wetland Complex	Cambridge	19	Waterloo	Woolwich	40P/8, 40P/9
114.	405	5	Blooming-dale/Rosen-dale Wetland	Cambridge	12	Waterloo	Woolwich	40P/8, 40P/9
115.	406	2	Portugese Swamp	Cambridge	11	Waterloo	Cambridge	40P/8
116.	407	1	Galt Creek Swamp	Cambridge	38	Waterloo, Wellington	Cambridge, North Dumfries, Puslinch	40P/8, 40P/9
117.	408	1	Puslinch Lake	Cambridge	3	Wellington	Puslinch	40P/8
118.	409	6	Irish Creek Swamp	Cambridge	1	Wellington	Puslinch	40P/8

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
119.	410	1	Oil Well bog/Little Tract	Cambridge	11	Wellington	Puslinch	40P/8
120.	411	2	Cranberry Bog/ Downey Rd. Swamp	Cambridge	5	Wellington	Puslinch	40P/8
121.	412	3	Hanlon Creek Swamp	Cambridge	1	Wellington	City of Guelph	40P/8, 40P/9
122.	413	2	Hall's Pond	Cambridge	15	Wellington	City of Guelph, Puslinch	40P/8, 40P/9
123.	414	5	Wolverton Swamp	Cambridge	1	Oxford	Blandford-Blenheim	40P/8, 40P/7
124.	415	6	Maryhill Swamp	Cambridge	2	Waterloo	Woolwich	40P/9
125.	416	5	Ellis Creek Swamp	Cambridge	4	Waterloo, Wellington	Woolwich, Guelph, City of Guelph	40P/9
126.	417	5	North Woolwich Swamp	Cambridge	1	Waterloo, Wellington	Woolwich, Pilkington	40P/9, 40P/10
127.	418	4	Marden South Wetland	Cambridge	35	Wellington	Guelph, City of Guelph	40P/9
128.	419	2	Guelph Northeast Complex	Cambridge	12	Wellington	Guelph, City of Guelph, Puslinch, Eramosa	40P/9
129.	420	5	Hamilton Corners Wetland	Cambridge	17	Wellington	City of Guelph, Puslinch	40P/9
130.	421	5	Arkell Bog	Cambridge	4	Wellington	Puslinch	40P/9

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
131.	422	4	Arkell-Corwhin Complex	Cambridge	22	Wellington, Halton	Puslinch, Milton	40P/9
132.	423	5	Knatchbull Swamp Complex	Cambridge	9	Halton	Milton	40P/9
133.	424	7	177-1	Cambridge	1	Halton	Milton	40P/9
134.	425	7	178-1	Cambridge	2	Halton	Milton	40P/9
135.	426	1	Eramosa River Valley/Blue Springs Creek	Cambridge	5	Halton, Wellington	Eramosa, Erin, Milton, Halton Hills	40P/9
136.	427	7	167-3	Cambridge	4	Halton	Halton Hills	40P/9
137.	428	7	167-2	Cambridge	3	Halton	Halton Hills	40P/9
138.	429	7	167-1	Cambridge	1	Halton	Halton Hills	40P/9
139.	430	1	Inverhaugh Valley Wetland	Cambridge	9	Wellington	Pilkington	40P/9
140.	431	4	Salem South Wetland Complex	Cambridge	8	Wellington	Pilkington	40P/9
141.	432	5	Irvine Crk. Wetland Complex	Cambridge	5	Wellington	Nichol, West Garafraxa	40P/9, 40P/16
142.	433	1	Speed River Complex	Cambridge	84	Wellington, Dufferin	Erin	40P/9
143.	434	5	South Ospringe/ Hwy. 25 Swamp	Cambridge	1	Wellington	Erin	40P/9
144.	435	5	Northeast Ospringe	Cambridge	6	Wellington	Erin	40P/9

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
145.	436	5	Crewsons Corners	Cambridge	10	Wellington	Erin	40P/9
146.	437	1	Ballinafad Ridge	Cambridge	53	Wellington	Erin	40P/9
147.	438	1	Alma Wetland Complex	Cambridge	44	Wellington	Peel	40P/10, 40P/15
148.	439	5	Ritch Tract Swamp	Cambridge	11	Wellington	Peel	40P/15, 40P/16
149.	440	5	Wagram Wetland Complex	Cambridge	2	Wellington	Arthur	40P/15
150.	441	1	Clare Creek Complex	Cambridge	5	Wellington	Arthur, West Luther	40P/15
151.	442	5	Derrynane Swamp	Cambridge	1	Wellington	Arthur, West Luther	40P/15
152.	443	5	Damascus Wetland Complex	Cambridge	11	Wellington	West Luther	40P/15, 40P/16
153.	468	7	OT3	Aylmer	1	Oxford	East Zorra	40P/7
154.	469	7	OT10	Aylmer	1	Oxford	East Zorra	40P/7
155.	470	7	OT11	Aylmer	1	Oxford	East Zorra	40P/7
156.	471	7	OT9	Aylmer	1	Oxford	East Zorra	40P/7
157.	472	7	OT6, OT7	Aylmer	2	Oxford	East Zorra	40P/7
158.	473	7	OB12	Aylmer	1	Oxford	East Zorra	40P/7
159.	474	7	OT12	Aylmer	1	Oxford	East Zorra	40P/7
160.	475	7	OB18, OB19	Aylmer	2	Oxford	Blandford-Blenheim	40P/7
161.	477	7	North Seneca Wetland	Cambridge	6	H-W	Glanbrook	30M/4

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
162.	478	4	Washington Creek Wetland	Cambridge	4	Oxford, Waterloo	Blandford-Blenheim, Wilmot	40P/7
163.	479	4	Lower Alder Creek Wetland	Cambridge	3	Oxford, Waterloo	Blandford-Blenheim, Wilmot	40P/7
164.	480	4	Upper Alder Creek Wetland	Cambridge	9	Waterloo	Wilmot	40P/7
165.	481	5	Petersburg Bog	Cambridge	4	Waterloo	Wilmot	40P/7
166.	482	5	Hofstetter Lake Wetland	Cambridge	11	Waterloo	Wilmot	40P/7
167.	483	5	Spongy Lake	Cambridge	1	Waterloo	Wilmot	40P/7
168.	484	5	Josephs-burg Swamp	Cambridge	2	Waterloo	Wilmot	40P/7
169.	485	1	Sunfish Lake Wetland Complex	Cambridge	28	Waterloo	Wilmot, Wellesley, Waterloo, Woolwich	40P/7, 40P/10
170.	486	4	Bamberg Bog	Cambridge	11	Waterloo	Wellesley	40P/7, 40P/10
171.	491	5	Shake-speare Hills/Avon Banks	Wingham	17	Perth	North Easthope	40P/7
172.	492	4	Gads Hill Swamp South	Wingham	25	Perth	North Easthope	40P/7
173.	494	2	Ellice Swamp	Wingham	4	Perth	Ellice	40P/7, 40P/10
174.	495	4	Silver Creek Complex	Wingham	4	Perth	North Easthope	40P/7

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
175.	496	6	Ratzburg Complex	Wingham	5	Perth	North Easthope	40P/7
176.	497	6	Brunner Complex	Wingham	2	Perth	Mornington	40P/1
177.	502	5	Cardwell Swamp	Huronia	4	Dufferin	Amaranth, Mono	40P/16
178.	503	6	Melancthon 35	Huronia	1	Dufferin	Melancthon	41A/1
179.	505	3	Keldon Swamp Wetland Complex	Owen Sound	4	Grey	Proton	41A/1
180.	506	2	Living Springs Complex	Cambridge	14	Wellington	West Gara-fraxa	40P/16
181.	507	1	North Cumnock Complex	Cambridge	23	Wellington	West Gara-fraxa, Peel, Nichol	40P/16
182.	508	3	Reading Swamp	Huronia	1	Dufferin	East Gara-fraxa	40P/16
183.	509	2	Mud Lake East Garafraxa	Huronia	1	Dufferin	East Gara-fraxa, Amaranth	40P/16
184.	510	2	Laurel Wetland Complex	Huronia	3	Dufferin	Amaranth	40P/16
185.	511	6	Farmington Swamp	Huronia	1	Dufferin	Amaranth	40P/16
186.	512	4	Whittington Complex	Huronia	8	Dufferin	Amaranth	40P/16, 41A/1
187.	513	1	Bowling Green Swamp	Huronia	1	Dufferin	Amaranth	40P/16
188.	514	7	Campania Fen	Huronia	1	Dufferin	Amaranth	40P/16, 41A/1

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
189.	515	1	Luther Marsh	Cambridge	7	Wellington, Dufferin	West & East Luther	40P/16
190.	516	6	Maple Grove Bog	Huronia	3	Dufferin	Amaranth	41A/1
191.	517	5	Willow Brook Swamp	Huronia	2	Dufferin	Amaranth	41A/1
192.	518	6	AM7	Huronia	6	Dufferin	Amaranth	41A/1
193.	519	7	Dufferin 520 785: Melancthon 16	Huronia	1	Dufferin	Melancthon	41A/1
194.	520	7	Dufferin 510 790: Melancthon 11	Huronia	1	Dufferin	Melancthon	41A/1
195.	521	6	Dufferin 498 795: Melancthon	Huronia	2	Dufferin, Grey	Melancthon /Proton	41A/1
196.	522	5	Melancthon 151	Huronia	3	Dufferin	Melancthon	41A/1
197.	523	7	Melancthon 8	Huronia	1	Dufferin	Melancthon	41A/1
198.	524	7	Melancthon 26	Huronia	1	Dufferin	Melancthon	41A/1
199.	525	7	Melancthon 20	Huronia	1	Dufferin	Melancthon	41A/1
200.	526	5	Melancthon 38	Huronia	1	Dufferin	Melancthon /Amaranth	41A/1
201.	527	7	Melancthon 3133	Huronia	2	Dufferin	Melancthon	41A/1
202.	528	6	Melancthon 30	Huronia	1	Dufferin	Melancthon	41A/1
203.	529	7	Melancthon 19	Huronia	2	Dufferin	Melancthon	41A/1

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
204.	530	7	Melancthon 13	Huronia	1	Dufferin	Melancthon	41A/1
205.	531	7	Dufferin 511 855, Melancthon	Huronia	2	Dufferin	Melancthon	41A/1
206.	532	7	Melancthon 24	Huronia	1	Dufferin	Melancthon	41A/1
207.	533	7	Melancthon 7	Huronia	1	Dufferin	Melancthon	41A/1
208.	534	6	Dufferin 4	Huronia	6	Dufferin	Melancthon	41A/1
209.	535	7	Dufferin 518 853, Melancthon 15	Huronia	2	Dufferin	Melancthon	41A/1
210.	536	7	Melancthon 4	Huronia	1	Dufferin	Melancthon	41A/1
211.	537	6	Dufferin 574 845, Melancthon 36	Huronia	1	Dufferin	Melancthon	41A/1
212.	538	6	Dufferin 12, 13 & 14	Huronia	3	Dufferin	Melancthon	41A/1
213	539	7	Dufferin 5, Melancthon 22	Huronia	1	Dufferin	Melancthon	41A/1
214.	540	6	Dufferin 10 & 11	Huronia	4	Dufferin	Melancthon	41A/1
215.	541	6	Dufferin 3A, Melancthon 18	Huronia	1	Dufferin	Melancthon	41A/1
216.	542	5	Dufferin 3, Melancthon 2328	Huronia	2	Dufferin	Melancthon	41A/1
217.	543	6	Elmira Wetland Complex	Cambridge	13	Waterloo, Wellington	Woolwich, Peel	40P/10

Grand River Watershed Wetlands Information (Adapted from the OMNR Wetlands Inventory Database (1991))

No.	MNR No.	Class	Name	MNR District	Polygon Number	County	Township	Topo. Map No.
218.	544	7	Stirton South Swamp	Cambridge	1	Wellington	Peel	40P/10
219.	545	7	Goldstone South Wetland	Cambridge	2	Wellington	Peel	40P/10
220.	546	5	Creek Bank Valley Wetland	Cambridge	15	Wellington, Waterloo	Woolwich, Pilkington	40P/10

APPENDIX K: TOTAL NUMBER OF WETLANDS BY LOWER-TIER MUNICIPALITY AND CLASS

Number of Wetlands by Class and Lower-Tier Municipality (1997)

Number	Township	Class							Total
		1	2	3	4	5	6	7	
1.	Dunnville	19	24	3	—	—	—	—	46
2.	Haldimand	41	3	6	—	—	2	2	54
3.	Nanticoke	1	—	3	—	—	4	3	11
4.	Elma	—	—	—	—	—	—	—	—
5.	Onondaga	—	—	—	—	—	—	—	—
6.	Tuscarora	—	—	—	—	—	—	—	—
7.	Oakland	9	—	—	—	7	—	1	17
8.	City of Brantford	—	—	—	—	—	—	—	—
9.	Brantford	17	—	—	—	1	—	1	19
10.	Paris	—	—	—	1	—	—	—	1
11.	Glanbrook	—	—	—	—	—	—	6	6
12.	Ancaster	—	—	—	—	1	3	—	4
13.	North Dumfries	67	6	23	—	4	25	—	125
14.	South Dumfries	160	—	—	4	—	3	—	167
15.	Cambridge	22	21	—	—	—	—	1	44
16.	Puslinch	56	19	—	9	14	1	—	99
17.	East Oxford	—	—	5	—	22	7	10	44
18.	East Zorra/Grand Valley	—	—	—	—	—	—	7	7
19.	Wilmot	11	—	—	21	9	3	—	44
20.	Elora	—	—	—	—	—	—	—	—
21.	Fergus	—	—	—	—	2	—	—	2
22.	Drayton	—	—	—	—	—	—	—	—
23.	Milverton	—	—	—	—	—	—	—	—

Number of Wetlands by Lower-Tier Municipality and Class (1997)

Number	Township	Class							Total
		1	2	3	4	5	6	7	
24.	Mornington	—	—	—	—	—	2	—	2
25.	Wellesley	15	—	—	8	—	—	—	23
26.	Guelph	4	11	—	34	3	—	—	52
27.	City of Guelph	2	4	1	5	10	—	—	22
28.	Halton Hills	1	—	—	—	—	—	7	8
29.	Milton	1	—	—	13	9	—	4	27
30.	Ellice	—	1	—	—	—	—	—	1
31.	North Easthope	—	—	—	5	3	5	—	13
32.	South Easthope	—	—	—	—	—	—	—	—
33.	Melancthon	—	—	—	—	5	20	18	43
34.	Proton	—	—	5	—	—	2	2	9
35.	Arthur	3	2	—	—	3	—	—	8
36.	Village of Arthur	—	—	—	—	—	—	—	—
37.	Village of Dundalk	—	—	—	—	—	—	—	—
38.	West Luther	6	—	—	—	10	—	—	16
39.	East Luther	5	—	—	—	—	—	—	5
40.	Amaranth	1	4	—	8	4	8	2	27
41.	Wallace	—	—	—	—	—	—	—	—
42.	Maryborough	—	—	—	—	—	—	—	—
43.	Nichol	10	—	—	1	3	—	—	14
44.	Pilkington	8	—	—	8	10	—	—	26
45.	East Garafraxa	3	1	1	—	—	—	—	5
46.	Erin	67	—	—	—	17	—	—	84
47.	Osprey	—	—	—	—	—	—	—	—

Number of Wetlands by Lower-Tier Municipality and Class (1997)

Number	Township	Class							Total
		1	2	3	4	5	6	7	
48.	Eramosa	41	3	—	—	—	—	—	44
49.	West Garafraxa	49	13	—	—	3	—	—	65
50.	Peel	47	—	—	—	11	9	3	70
51.	Woolwich	7	—	—	—	36	8	1	52
52.	Burford	32	—	26	—	28	6	26	118
53.	Flamborough	78	—	—	18	—	—	—	96
54.	Blandford-Blenheim	73	2	2	8	2	4	17	108
55.	Kitchener	13	1	—	—	—	—	—	14
56.	Waterloo	11	—	—	—	—	—	—	11

APPENDIX L: CONTRIBUTING AREA BY LOWER-TIER MUNICIPALITY

Total Contributing Area by Percent Total Area of Lower-Tier Municipality (1997)

Municipality	Ha	%	Municipality	Ha	%
Eramosa	11874	62.8	Norwich	754.0	13.3
Puslinch	9954.5	54.5	E. Luther	753.3	4.6
Erin	9670.9	58.5	Waterloo	723.2	11.2
Bland.-Blen.	8088.7	23.1	Proton	688.5	18.4
N. Dumfries	8058.2	42.2	Arthur (T)	540.3	4.1
Burford	6123 4	42.9	N. Easthope	537.7	5.4
Melancthon	5742.1	31.5	Nanticoke	519.2	5.0
W. Garafraxa	5184.4	26.3	Halton Hills	382.5	45.6
Milton	4368.5	73.1	E. Zorra	278.2	10.1
Amaranth	4166.4	18.8	Ancaster	224.7	1.8
Woolwich	4067.1	12.3	Paris	105.9	7.0
Flamborough	3828.8	22.7	Glanbrook	38.5	6.0
Wilmot	3695.5	13.8	Fergus	24.5	3.4
S. Dumfries	3446.8	18.5	Mornington	23.9	0.2
Cambridge	2921.6	25.3	Ellice	11.3	1.3
Guelph (T)	2826.8	23.7	Osprey	6.13	39.0
E. Garafraxa	2737.4	18.9	Tuscarora	0.8	0.0
Peel	2521.8	8.1	Brantford (C)	n/a	n/a
Brantford (T)	2210.9	9.3	Onondaga	n/a	n/a
Haldimand	1984.0	5.5	Elora	n/a	n/a
Pilkington	1939.2	15.5	Drayton	n/a	n/a
Oakland	1915.9	41.7	Dundalk	n/a	n/a
W. Luther	1849.7	11.6	Milverton	n/a	n/a
Kitchener	1749.1	12.6	Elma	n/a	n/a
Dunnville	1677.5	10.9	S. Easthope	n/a	n/a
Wellesley	1218.8	4.4	Arthur (V)	n/a	n/a
Nichol	1032.9	9.9	Wallace	n/a	n/a
Guelph (C)	1010.4	14.5	Maryborough	n/a	n/a

Total High Contributing Area by Lower-Tier Municipality (1997)

Municipality	Ha	%	Municipality	Ha	%
Eramosa	4568.2	24.2	Guelph (C)	261.4	3.8
Erin	4148.9	25.1	Proton	241.5	6.5
S. Dumfries	2223.6	11.9	E. Luther	217.9	1.4
Bland.-Blen.	1926.6	5.5	Waterloo	167.5	2.6
Puslinch	1899.6	10.4	N. Easthope	150.6	1.5
N. Dumfries	1870.7	9.8	Nanticoke	136.1	13.1
Burford	1628.9	11.4	Ancaster	122.6	1.0
Wilmot	1241.3	4.7	Arthur (T)	110.4	0.8
Flamborough	1233.8	7.3	E. Zorra	101.3	3.7
Melancthon	1224.8	6.7	Paris	66.2	4.4
Guelph (T)	1215	10.2	Halton Hills	55.2	6.6
W. Garafraxa	1169.3	5.9	Glanbrook	13.3	0.2
Kitchener	1112.1	8.0	Mornington	12.0	0 0
Amaranth	1077.9	4.9	Fergus	10.9	1.5
Peel	922.4	3.0	Ellice	7.4	0.9
Woolwich	866.2	2.6	Brantford (C)	1.72	0.0
Haldimand	818.2	2.3	Tuscarora	n/a	n/a
Wellesley	687.9	2.5	Osprey	n/a	n/a
Pilkington	640.2	5.1	Onondaga	n/a	n/a
Nichol	606.9	5.8	Elora	n/a	n/a
E. Garafraxa	542.9	3.8	Drayton	n/a	n/a
Milton	535.7	8.9	Dundalk	n/a	n/a
Dunnville	534.9	3.5	Milverton	n/a	n/a
Cambridge	517.9	4.5	Elma	n/a	n/a
Oakland	507.1	11.0	S. Easthope	n/a	n/a
W. Luther	460.5	2.9	Arthur (V)	n/a	n/a
Norwich	420.3	7.4	Wallace	n/a	n/a
Brantford (T)	379.4	1.6	Maryborough	n/a	n/a

Total Moderate Contributing Area by Lower-Tier Municipality(1997)

Municipality	Ha	%	Municipality	Ha	%
Eramosa	3076.5	16.3	Arthur (T)	93.5	0.7
Melancthon	1249.7	6.8	Brantford (T)	90.5	0.4
Erin	1244.1	7.5	Cambridge	55.9	0.5
Bland.-Blen.	1219.3	3.5	Nanticoke	44.1	0.4
Amaranth	1207.6	5.5	Halton Hills	18.2	2.2
Burford	1122.9	7.9	Wellesley	13.3	0.0
Peel	904.2	2.9	Fergus	10.6	1.5
W. Garafraxa	680.4	3.5	Mornington	9.3	0.0
Woolwich	676.7	2.1	Ancaster	5.1	0.0
Flamborough	624.9	3.7	Waterloo	2.6	0.0
Guelph (T)	610.4	5.1	Nichol	2.1	0.0
Pilkington	498.9	4.0	Kitchener	0.4	0.0
W. Luther	454.4	2.8	Paris	n/a	n/a
E. Garafraxa	390.5	2.7	Brantford (C)	n/a	n/a
Norwich	387.1	6.8	Ellice	n/a	n/a
Dunnville	323.5	2.1	Glanbrook	n/a	n/a
Haldimand	304.9	0.8	Tuscarora	n/a	n/a
E. Luther	247.9	1.5	Osprey	n/a	n/a
Milton	211.2	3.5	Onondaga	n/a	n/a
N. Dumfries	204.6	1.0	Elora	n/a	n/a
Oakland	169.7	3.7	Drayton	n/a	n/a
Proton	164.6	4.4	Dundalk	n/a	n/a
N.Easthope	161.5	1.6	Milverton	n/a	n/a
Puslinch	157.2	0.9	Elma	n/a	n/a
Guelph (C)	137.6	2.0	S. Easthope	n/a	n/a
Wilmot	121.7	0.5	Arthur (V)	n/a	n/a
E. Zorra	97.0	3.5	Wallace	n/a	n/a
S. Dumfries	96.2	0.5	Maryborough	n/a	n/a

Total Low Contributing Area by Lower-Tier Municipality (1997)

Municipality	Ha	%	Municipality	Ha	%
Puslinch	7897.8	43.3	Nichol	423.9	4.1
N. Dumfries	5982.8	31.3	Norwich	354.7	6.2
Bland.-Blen.	4942.8	14.1	Nanticoke	339.1	32.7
Erin	4278.0	25.9	Arthur (T)	336.3	2.6
Eramosa	4229.9	22.4	Halton Hills	309.2	36.8
Milton	3621.5	60.5	E. Luther	287.4	1.7
Burford	3372	23.6	Proton	282.4	7.6
Melancthon	3267.6	17.9	N. Easthope	225.7	2.3
Woolwich	2524.2	7.7	Ancaster	96.9	0.8
Cambridge	2347.7	20.3	E. Zorra	79.9	2.9
Wilmot	2331.5	8.7	Paris	39.8	2.6
W. Garafraxa	2165.4	11.0	Glanbrook	25.2	0.4
Flamborough	1970.1	11.7	Osprey	6.13	38.8
Amaranth	1880.9	11.7	Ellice	3.9	0.0
E. Garafraxa	1804.0	12.5	Fergus	2.9	0.4
Brantford (T)	1361.8	5.7	Mornington	2.6	0.0
Oakland	1239.2	27.0	Tuscarora	n/a	n/a
S. Dumfries	1127.0	6.0	Brantford (C)	n/a	n/a
Guelph (T)	1001.4	8.4	Onondaga	n/a	n/a
W. Luther	934.9	5.8	Elora	n/a	n/a
Haldimand	860.9	2.4	Drayton	n/a	n/a
Dunnville	819.1	5.3	Dundalk	n/a	n/a
Pilkington	800.0	6.4	Milverton	n/a	n/a
Peel	695.2	2.2	Elma	n/a	n/a
Kitchener	636.6	4.6	S. Easthope	n/a	n/a
Guelph (C)	611.5	8.8	Arthur (V)	n/a	n/a
Waterloo	553.1	8.5	Wallace	n/a	n/a
Wellesley	517.7	1.9	Maryborough	n/a	n/a

APPENDIX M: POPULATION CHANGE AND DENSITY FROM 1986-1994 IN THE LOWER-TIER MUNICIPALITIES

Change in Population and Density (1986-1994) in the Lower-Tier Municipalities (1997)

Municipality	Population (1986)	Population (1994)	Census Area (ha)	% Change ('86-'94)	Density ('86-'94)
Wilmot	11145	13135	26205	17.8	0.43-0.50
East Zorra	7095	7370	24505	3.8	0.29-0.30
Cambridge	79920	99000	11564	23.8	6.91-8.56
North Dumfries	5221	7090	18454	35.8	0.28-0.38
Puslinch	4887	4607	23108	(5.7)	0.21-0.19
Norwich	9526	10302	43395	8.1	0.22-0.23
Ancaster	17264	22810	17455	32.1	1.00-1.31
Glanbrook	9592	10238	20274	6.7	0.47-0.50
Brantford	6287	6241	23960	<0.01	0.26-0.26
City of Brantford	76146	81074	7123	6.5	10.69-11.38
Paris	8088	8552	1364	5.7	5.93-6.27
Oakland	1233	1336	4543	8.3	0.27-0.29
Tuscarora	n/a	n/a	n/a	n/a	n/a
Onondaga	1299	1627	8711	25.3	0.15-0.19
Nanticoke	20202	22401	67472	10.8	0.30-0.33
Haldimand	17701	20824	63815	17.6	0.28-0.33
Dunnville	11589	11908	30292	2.8	0.38-0.39
Elora	2799	3116	351	11.3	7.97-8.87
Fergus	6275	8008	723	27.6	8.68-11.08
Drayton	820	1333	186	62.5	4.41-7.16
Dundalk	1295	1566	187	20.9	6.92-8.37
Milverton	1557	1660	178	6.6	8.75-9.33
Mornington	3097	3355	20451	8.3	0.15-0.16
Wellesley	7064	8392	27402	18.8	0.26-0.26
Guelph	3014	3045	11804	1.0	0.26-0.26

Municipality	Population (1986)	Population (1994)	Census Area (ha)	% Change ('86-'94)	Density ('86-'94)
City of Guelph	78235	93000	6872	18.8	11.38-13.5
Halton Hills	35570	38763	27586	8.8	1.29-1.41
Elma	3890	3978	27379	2.2	0.14-0.15
Ellice	2978	3114	22699	4.6	0.13-0.14
North Easthope	2104	2102	17695	<0.01	0.12-0.12
South Easthope	1781	1837	9755	3.1	0.18-0.19
Melancthon	2149	2286	31239	6.4	0.07-0.07
Proton	1491	1783	33754	5.7	0.04-0.05
Arthur	2032	2472	27001	21.3	0.08-0.09
Village of Arthur	1842	1960	392	17.2	4.70-5.00
West Luther	1054	1114	20602	5.7	0.05-0.05
East Luther	2091	2537	16213	21.3	0.13-0.16
Amaranth	2771	3247	26532	17.2	0.10-0.12
Wallace	2253	2382	20508	5.7	0.10-0.12
Maryborough	2448	2573	23094	5.1	0.10-0.11
Nichol	3593	3999	10831	11.3	0.33-0.37
Pilkington	2012	2369	12341	17.7	0.16-0.19
East Garafraxa	1841	2037	16513	10.6	0.11-0.12
Erin	6365	7468	29416	17.3	0.22-0.25
Osprey	1736	1996	29409	14.9	0.05-0.07
Eramosa	4713	5764	18865	22.3	0.25-0.31
West Garafraxa	2582	3341	18935	29.4	0.14-0.18
Peel	3941	4294	30441	8.9	0.13-0.14
Woolwich	16732	16711	32388	<0.01	0.52-0.52
Burford	5227	5712	27639	9.3	0.19-0.21
Flamborough	26142	29700	48990	13.6	0.53-0.61
South Dumfries	4019	5103	18193	26.9	0.22-0.28

Municipality	Population (1986)	Population (1994)	Census Area (ha)	% Change ('86-'94)	Density ('86-'94)
Bland-Blenheim	6731	7157	39539	6.3	0.17-0.18
Kitchener	150604	180000	13515	19.5	11.14-13.32
Waterloo	58718	89663	6443	52.7	9.11-13.92
Milton	32037	30278	36720	0.1	0.87-0.82
TOTAL	782798	917730	1155021	+13.58	1.93-2.32

APPENDIX N: DWELLING DENSITY IN THE LOWER-TIER MUNICIPALITIES

Dwelling Density in the Lower-Tier Municipalities (1997)

Municipality	Census Area (ha)	Number of Dwellings (1991)	Number of Dwellings (1994)	Density of Dwellings (1991)	Density of Dwellings (1994)
Wilmot	26205	4330	4589	0.16	0.17
East Zorra	24505	2264	2456	0.09	0.10
Cambridge	11564	31895	36000	2.76	3.11
North Dumfries	18454	2421	2175	0.11	0.13
Puslinch	23108	1717	1747	0.07	0.07
Norwich	43395	3231	3455	0.07	0.08
Ancaster	17455	6879	7505	0.39	0.43
Glanbrook	20274	3080	3345	0.15	0.16
Brantford	23960	2095	2167	0.08	0.09
City of Brantford	7123	30487	33000	4.28	4.63
Paris	1364	3052	3233	2.24	2.37
Oakland	4543	458	472	0.10	0.10
Tuscarora	n/a	n/a	n/a	n/a	n/a
Onondaga	8711	498	540	0.05	0.06
Nanticoke	67472	7960	9369	0.12	0.14
Haldimand	63815	6883	8471	0.11	0.13
Dunnville	30292	4288	5209	0.14	0.17
Elora	351	1142	1207	3.25	3.44
Fergus	723	2917	3182	4.03	4.40
Drayton	186	401	484	2.15	2.60
Dundalk	187	638	694	3.40	3.71
Milverton	178	585	607	3.28	3.4
Mornington	20451	831	908	0.04	0.04
Wellesley	27402	2303	2470	0.08	0.09
Guelph	11804	995	1014	0.08	0.08

Municipality	Census Area (ha)	Number of Dwellings (1991)	Number of Dwellings (1994)	Density of Dwellings (1991)	Density of Dwellings (1994)
City of Guelph	6872	32751	35929	4.77	5.23
Halton Hills	27568	12206	13646	0.44	0.49
Elma	27379	1278	1352	0.05	0.05
Ellice	22699	951	1018	0.04	0.04
North Easthope	17695	663	703	0.04	0.04
South Easthope	9755	583	616	0.06	0.06
Melancthon	31239	794	963	0.03	0.03
Proton	33754	644	811	0.02	0.02
Arthur	27001	798	886	0.03	0.03
Village of Arthur	392	761	810	1.94	2.06
West Luther	20602	345	408	0.02	0.02
East Luther	16213	852	926	0.05	0.06
Amaranth	26532	960	1125	0.04	0.04
Wallace	20508	677	718	0.03	0.04
Maryborough	23094	808	1192	0.03	0.05
Nichol	10831	1218	1325	0.11	0.12
Pilkington	12341	709	782	0.06	0.06
East Garafraxa	16513	608	710	0.04	0.04
Erin	29416	2397	2680	0.08	0.09
Osprey	29409	915	993	0.03	0.03
Eramosa	18865	1909	2064	0.10	0.11
West Garafraxa	18935	1126	1518	0.06	0.08
Peel	30441	1135	1250	0.03	0.04
Woolwich	32388	5542	5748	0.17	0.18
Burford	27639	1910	2029	0.07	0.07
Flamborough	48990	9623	10483	0.19	0.21

Municipality	Census Area (ha)	Number of Dwellings (1991)	Number of Dwellings (1994)	Density of Dwellings (1991)	Density of Dwellings (1994)
South Dumfries	18193	1500	1897	0.08	0.10
Blandford-Blenheim	39539	2382	2503	0.06	0.06
Kitchener	13515	62382	68240	4.60	5.05
Waterloo	6443	27071	30205	4.20	4.68
Milton	36720	10085	10471	0.27	0.29
TOTAL/MEANS	1155021	306933	338300	0.80	0.88

APPENDIX O: RESPONDENTS GENERAL COMMENTS

(I) Comments Regarding a Landowner Stewardship Program

- "A landowner stewardship program would assist in informing landowners on the merit of wetland protection and could provide much needed networking. Given the current fiscal position of most muncipalities, it is questionable whether such a program could be delivered through the municipalities. It would seem that it may be better offered through other vehicles."
- "There is no money at the municipal level to deal with a stewardship program."
- "Maybe, would need more information."
- "Yes, beneficial, but not necessarily in our municipality."
- "No $$, no resources."
- "Cost?"

(II) Comments Regarding the resources Municipalities' feel would assist them to effectively protect wetlands

- "Grants and programs need to be directed toward the agriculture sector to improve farming practices."
- "The problem would largely lie with the fact that dollars are limited and council chooses to direct available resources (financial) to those areas with immediate economic response with little regard for long term effects. I believe money would have to be made available for this purpose alone by an outside agency."
- "Not enough staff expertise or time to evaluate EIS. Policies and ministries would be relied upon."
- "Policies too permissive and have not been updated yet."
- "$$$ and expert staff required."
- "Additional staff and resources."
- "Municipalities need provincial support in terms of policy and expertise for identifying wetlands and reviewing EIS for development proposals contiguous to wetlands."
- "Additional skills in biology, resource economics (wetland valuation). Ability to confirm Provincial evaluations or conduct our own."

- "Our council prefers that MNR lead in the protection of wetlands. I believe that with the political will and a trained staff person we could do it."
- "Enforcement not available to protect, regrading, site alterations."
- "Up-to-date wetland information for the Township-advice regarding Provincial protection policies."
- "More education programs for staff and public."
- "Not sufficient number of staff to administer and enforce. Staff already doing 2-3 additional jobs beyond their regular job descriptions."
- "Financial."
- "Municipalities do not always have the technical expertise to conduct wetland evaluations and technically review EISs prepared by applicants."
- "Expertise in reviewing EIAs lacking."

(III) Comments Regarding the resources Municipalities' feel exist at present within the municipality to effectively protect wetlands

- "Through policy formulation and regulation in local planning documents (OP and Zoning by-laws."
- "Policies in approved OP require the protection wetlands. Local OPs must conform to Regional OP."
- "Policies and staff."
- "Regulatory tools and expertise available."
- "Few wetlands in City. Major ones which exist are already protected."
- "City has effective policies and an established watershed planning program."
- "I don't feel wetlands are endangered from development. Upland woodlots are much more susceptible (ie. No policy statement, no floodplain regulation). The real problem for environment is agriculture."
- "Professional staff available to implement policies."

- "Much time was spent on developing the natural environment policies in the OP and identifying lands to be protected."
- "The Township's Zoning by-law/OP and representatives protect wetlands whenever required."
- "Very clear OP policies; up-to-date mapping."
- "Our OP was adopted the day before Bill 163 was implemented. Our review in five years will have to incorporate provincial policies not presently found in the OP."

(IV) Comments Regarding whether changes to the Planning Act will influence decision-making

- "New OP developed prior to Bill 163-however, it does embrace environmental protection."
- "I don't think so, the Township has always taken into consideration the protection of wetlands when considering any development."
- "Not yet and Bill 163 is on the way out."
- "Council did not update OP or Zoning by-law to comply with changes of legislation and no current plans to do so."
- "Largely the changes has resulted because of staff procedure, requiring an EIS prior to a recommendation to council being made. Council appears to have little regard otherwise."
- "Official plan zoning by-law currently designate these areas as hazard land-no development permitted."
- "Policies not updated yet."
- "We have not had the time to implement 163; especially now that new government is in place."
- "Policies have been modified to reinforce the direction mandated by the Province."
- "New County Official Plan has incorporated Provincial policy on wetland protection."

- "Our official plan reflects the previous wetlands policy statement and will not be affected by the ups and downs of Bill 163."
- "Bill 163 confirmed our earlier approach that wetlands were to be protected due to the provincial policy on wetlands. We still have to revise the local plans and their zoning by-laws."
- "Changes to City's Zoning and OP made based on previous wetland policy statement."
- "Wetlands are not a major issue here and Bill 163 has not improved our data or changed our current protection policies."
- "Haven't had an OP review or new development applications."
- "Has increased municipal awareness of the need to protect wetlands. Planning staff use Bill 163 in their discussions with Councils when reviewing OP documents."
- "Provincial position remains essentially unchanged in that only Provincially significant wetlands must be protected."
- "New Regional OP approved under old Planning Act. Wetlands Protection is included in the OP based on the requirements of the wetlands policy statement."
- "Policies are the same as in the old wetlands policy statement; no change."
- "No wetland issues since 163."
- "No changes required."
- "Council had already made the commitment and necessary policy review to address wetland protection."
- "Almost all of our Plans already protect provincially significant wetlands. Many protect classes 4-7."
- "Great flexibility around policy development and an approach to a more clearer understanding."
- "It is not likely to change as our municipality has always considered protection of the natural environment areas to be important."

(V) Comments Regarding whether wording changes would affect the muncipality's wetland protection

- "Importance of wetland and environmentally sensitive lands transcends the terminology distinction."
- "The Township's official plan/zoning by-law and policies/regulations will always provide for wetland protection."
- "Because council has not changed policies to 'be consistent with'."
- "I believe council will continue as in the past and allow staff to make decisions regarding requirements for an EIS. However, council will not always have regard for staff's recommendations and view the proposed changes as a 'free-for-all'."
- "Policies not updated yet."
- "Not an issue anymore."
- "It is council's intention to protect wetlands from the adverse impacts of poor planning decisions."
- "Not likely, the general intent will be maintained."
- "It is already in our plan which implements Vision 2020, A Strategic Vision for our Region which includes wetlands protection as a goal."
- "We will still protect the wetlands. Planning staff feels it means the same thing."
- "City's documents prepared based on Policy Statement."
- "Our OP and By-law were prepared in consistency with Provincial policies. The change in wording does not alter our relationship with Provincial enforcement."
- "Few wetlands in municipality."
- "Planning Office expects that muncipalities will still protect the Provincially significant wetlands."
- "No, Regional Plan protects wetlands in accordance with the old wetlands policy statement."
- "Commitment is already there to protect provincially significant wetlands."

- "No effective changes anticipated being required."
- "Yes, because it will allow the local council to weigh wetland preservation against other important municipal objectives."
- "Most wetlands are also protected already by Hazard zoning. People do not want to develop in a wetland. Yet there is nothing to stop a farmer from draining."
- "In the process of OP update currently treated with high regard."

(VI) Other Comments

- "I hope that your research won't be for not, with the changes to the Planning Act. The change to the mandate of the GRCA was a letdown. They were far more "accountable" and approachable than the MNR."
- "Under the former government, the MNR brought in unilaterally designated wetlands and imposed many restrictions. The Harris government is making many changes in planning issues. It remains to be seen how extensive they will be."

APPENDIX P: OFFICIAL PLAN DATES OF ADOPTION, APPROVAL AND REVIEW

Official Plan Dates of Adoption, Approval and Review (1997)

Municipality	Council Adopted	Ministry Approved	Review
REGION			
Halton	March 30, 1994	May 17, 1995	n/a
Hamilton-Wentworth	June 7, 1994	January 5, 1995	n/a
Haldimand-Norfolk	September 28, 1995	April, 1996	n/a
Waterloo	May 11, 1995	December 19, 1995	n/a
COUNTY			
Dufferin	n/a	n/a	n/a
Wellington	November 24, 1988	January 23, 1992	next 2 years
Perth	n/a	n/a	n/a
Oxford	August 20, 1996	March 31, 1997	n/a
Brant	n/a	n/a	n/a
Grey	July 22, 1981	as amended Oct. 1985	mid-1996
CITY			
Nanticoke	October 23, 1980	October 20, 1989	n/a
Cambridge	July, 1982	1983-1985	newly adopted Sept.'97
Kitchener	May 24, 1994	May 25, 1995	n/a
Waterloo	June 28, 1990	November, 1994	n/a
Brantford	August, 1994	June 1, 1995	n/a
Guelph	November 1, 1994	December 20, 1995	n/a
TOWN			
Dunnville	May 27, 1982	last amended Dec. '93	n/a
Haldimand	September 25, 1980	October 2, 1984	under revision
Milton	August 26, 1996 (reg'l)	n/a	n/a
Halton Hills	February 7, 1985	October, 1994	n/a
Ancaster	March 26, 1984	July 6, 1984	underway, 2 years
Flamborough	June 6, 1988	September 27, 1988	next 2-3 years
Paris	January, 1988	n/a	next 2 years

Municipality	Council Adopted	Ministry Approved	Review
TOWN			
Fergus	November 4, 1991	October 6, 1993	n/a
TOWNSHIP			
Glanbrook	October 21, 1985	June 16, 1987	ongoing
North Dumfries	December 21, 1981	n/a	working on new OP
Wilmot	November 24, 1980	Jan. 29, 1981 (reg'l)	soon, new Waterloo OP
Wellesley	November 6, 1980	July 14, 1981 (reg'l)	soon, new Waterloo OP
Woolwich	November 25, 1980	n/a	soon, new Waterloo OP
Brantford	June 1, 1995	n/a	within 5 years
Burford	December, 1984		'99, Brant restructure
Oakland	December 10, 1984	n/a	'99, Brant restructure
Onondaga	February 18, 1991	August 2, 1994	n/a
South Dumfries	November 22, 1994	n/a	n/a
Amaranth	1988	revised July, 1990	n/a
East Garafraxa	August 5, 1980	July 20, 1981	n/a
Maryborough	August 29, 1988	February 18, 1988	within 5 years
Nichol	December 16, 1992	May 10, 1996	n/a
Peel	November 18, 1991	July 30, 1993	n/a
Pilkington	August 16, 1994	December 19, 1995	n/a
Puslinch	Sept., 1986, mod. '93	November 10, 1988	within 5 years
West Garafraxa	October 21, 1991	September 3, 1993	n/a
West Luther	March, 1991, mod. '93	n/a	n/a
East Luther/Gr. Valley	1975, November 1990	n/a	n/a
Melancthon	January 15, 1976	November 17, 1977	n/a
Osprey	December 19, 1986	n/a	n/a
Blandford-Blenheim	n/a	n/a	under Oxford OP
East Zorra-Tavistock	n/a	n/a	under Oxford OP

Municipality	Council Adopted	Ministry Approved	Review
TOWNSHIP			
Elma	December 14, 1992	December 2, 1994	n/a
Ellice	July 29, 1985	September 24, 1985	n/a
Mornington	July 29,'85; mod. '93	Oct. 7, '85; mod. '97	n/a
North Easthope	November 15, 1993	July 4, 1996	5 years
South Easthope	July 29, 1985	September 24, 1985	next 5 years
Norwich	n/a	n/a	under Oxford OP
Wallace	November 1993	October 1995	n/a
Tuscarora	n/a	n/a	n/a
Proton	n/a	n/a	under Grey OP
Arthur	December, 1994	partial December 1995	n/a
Eramosa	January, 1992	partial March 27, 1995	n/a
Erin	June, 1991, Dec. '92	December, 1995	n/a
Guelph	July 4, 1990	June 24, 1993	n/a
VILLAGE			
Dundalk	May 16, 1985	n/a	n/a
Milverton	July 29, 1985	October 7, 1985	n/a
Arthur	October 19, 1994	July 11, 1996	n/a
Drayton	February 17, 1992	April 11, 1994	n/a
Elora	June, 1991;Mar. 1997	early 1997	n/a

APPENDIX Q: RANKING OF OFFICIAL PLAN REVIEW

Ranking of Official Plan Review (1997)

Municipality	Q.#1	Q.#2	Q.#3	Q.#4	Q.#5	Q.#6	Total
COUNTY							
Dufferin	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wellington	3	3	3	0	3	4	16
Perth	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Oxford	5	5	5	4	5	4	28
Brant	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Grey	1	1	1	2	2	2	9
REGION							
Halton	3	2	2	5	4	4	20
Hamilton-Wentworth	5	5	5	5	5	4	29
Haldimand-Norfolk	5	5	5	5	5	5	30
Waterloo	5	5	5	5	4	5	29
CITY							
Nanticoke	2	2	2	3	2	4	15
Cambridge	4	3	3	5	4	5	24
Kitchener	5	5	5	5	4	5	29
Waterloo	1	2	0	0	2	4	9
Brantford	5	4	4	4	4	4	25
Guelph	3	2	2	4	3	4	18
TOWNS							
Dunnville	2	2	2	3	2	4	15
Haldimand	2	2	2	3	2	3	14
Milton	4	4	4	5	5	5	21
Halton Hills	2	2	2	3	2	4	15
Ancaster	2	3	2	3	3	4	17

Ranking of Official Plan Review (1997)

Municipality	Q.#1	Q.#2	Q.#3	Q.#4	Q.#5	Q.#6	Total
TOWNS							
Flamborough	3	3	3	4	3	4	20
Paris	2	2	2	4	2	4	16
Fergus	4	4	2	5	4	4	23
Glanbrook	2	2	2	4	3	3	16
North Dumfries	3	2	2	4	3	4	18
Wellesley	3	2	2	4	3	4	18
Wilmot	3	2	2	4	3	4	18
Woolwich	3	2	2	4	3	4	18
Brantford	1	1	0	0	0	3	5
Burford	1	3	0	2	3	4	13
Oakland	2	3	2	4	3	4	18
Onondaga	2	2	2	4	3	4	17
South Dumfries	4	4	3	4	4	4	23
Amaranth	2	3	2	4	3	4	18
East Garafraxa	2	3	2	4	2	4	17
Maryborough	1	1	1	1	0	4	8
Nichol	4	5	5	5	4	5	28
Peel	5	5	3	5	4	5	27
Pilkington	5	5	5	4	5	5	29
Puslinch	2	3	0	0	2	4	11
West Garafraxa	3	3	3	4	4	4	21
West Luther	3	4	2	3	2	4	18
East Luther/Grand Valley	2	2	2	4	3	4	17
Melancthon	2	2	2	3	3	4	16

Ranking of Official Plan Review (1997)

Municipality	Q.#1	Q.#2	Q.#3	Q.#4	Q.#5	Q.#6	Total
Osprey	2	3	2	3	3	3	16
Blandford-Blenheim	n/a	n/a	n/a	n/a	n/a	n/a	n/a
East Zorra-Tavistock	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Elma	3	2	2	1	3	4	15
Ellice	2	2	2	3	3	4	16
Mornington	4	4	0	0	2	3	13
North Easthope	4	4	4	4	4	4	24
South Easthope	3	1	1	1	3	3	12
Norwich	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wallace	2	3	1	0	3	2	11
Tuscarora	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Proton	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Arthur	1	2	0	0	0	4	7
Eramosa	4	3	4	5	4	5	25
Erin	2	2	3	4	3	4	18
Guelph	2	2	1	4	2	4	15
VILLAGES							
Dundalk	2	3	2	2	3	4	16
Milverton	0	0	0	0	0	2	2
Arthur	0	0	0	0	0	3	3
Drayton	1	1	1	3	2	3	11
Elora	1	0	0	0	0	2	3

NOTE TO USERS

Oversize maps and charts are microfilmed in sections in the following manner:

LEFT TO RIGHT, TOP TO BOTTOM, WITH SMALL OVERLAPS

The following map or chart has been microfilmed in its entirety at the end of this manuscript (not available on microfiche). A xerographic reproduction has been provided for paper copies and is inserted into the inside of the back cover.

Black and white photographic prints (17"x 23") are available for an additional charge.

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FIGURE 4.1: CENSUS SUBDIVISION NA

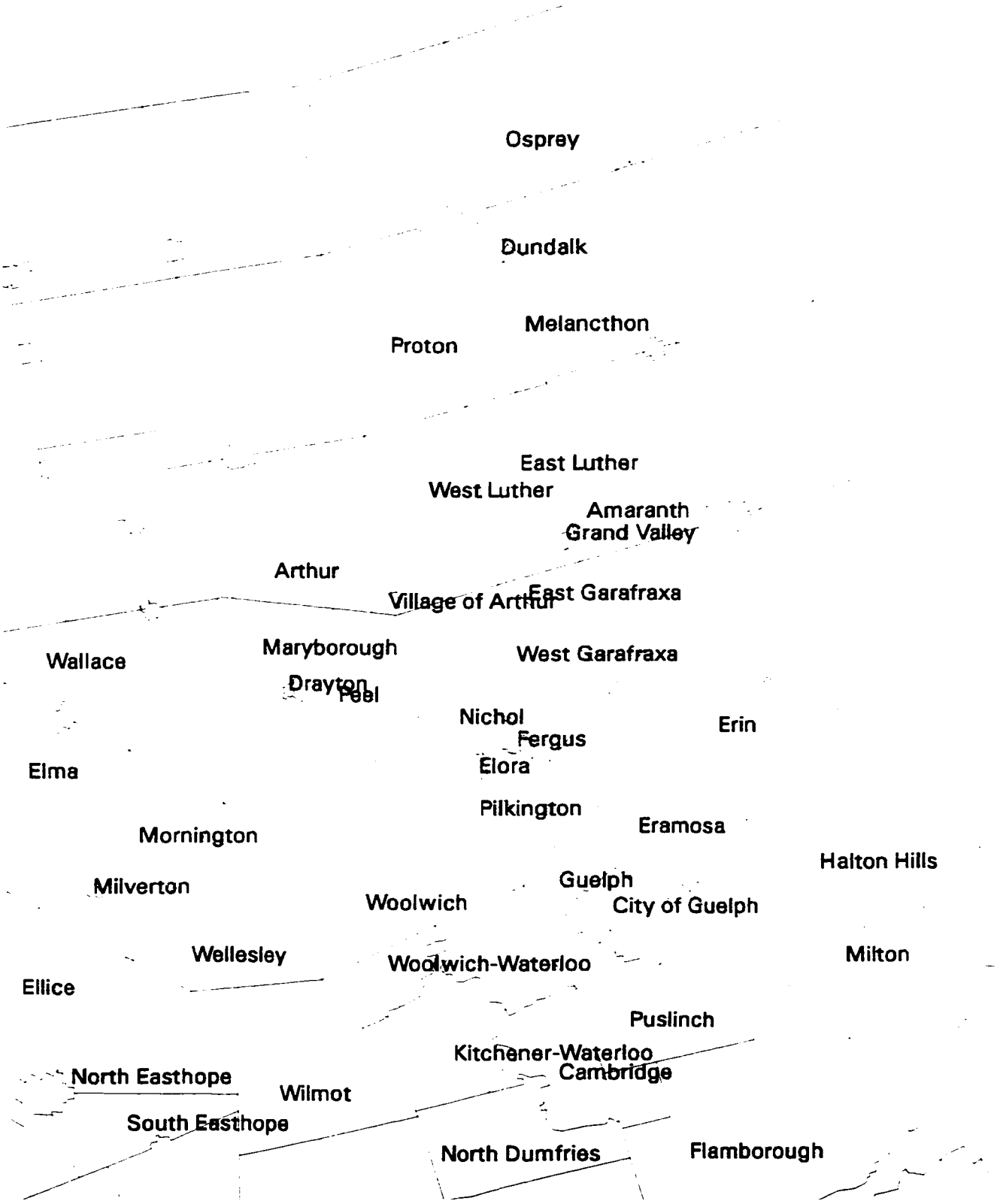

FIGURE 4.0: NON-POINT SOURCE
OVERLAND TO PROVINCIALLY
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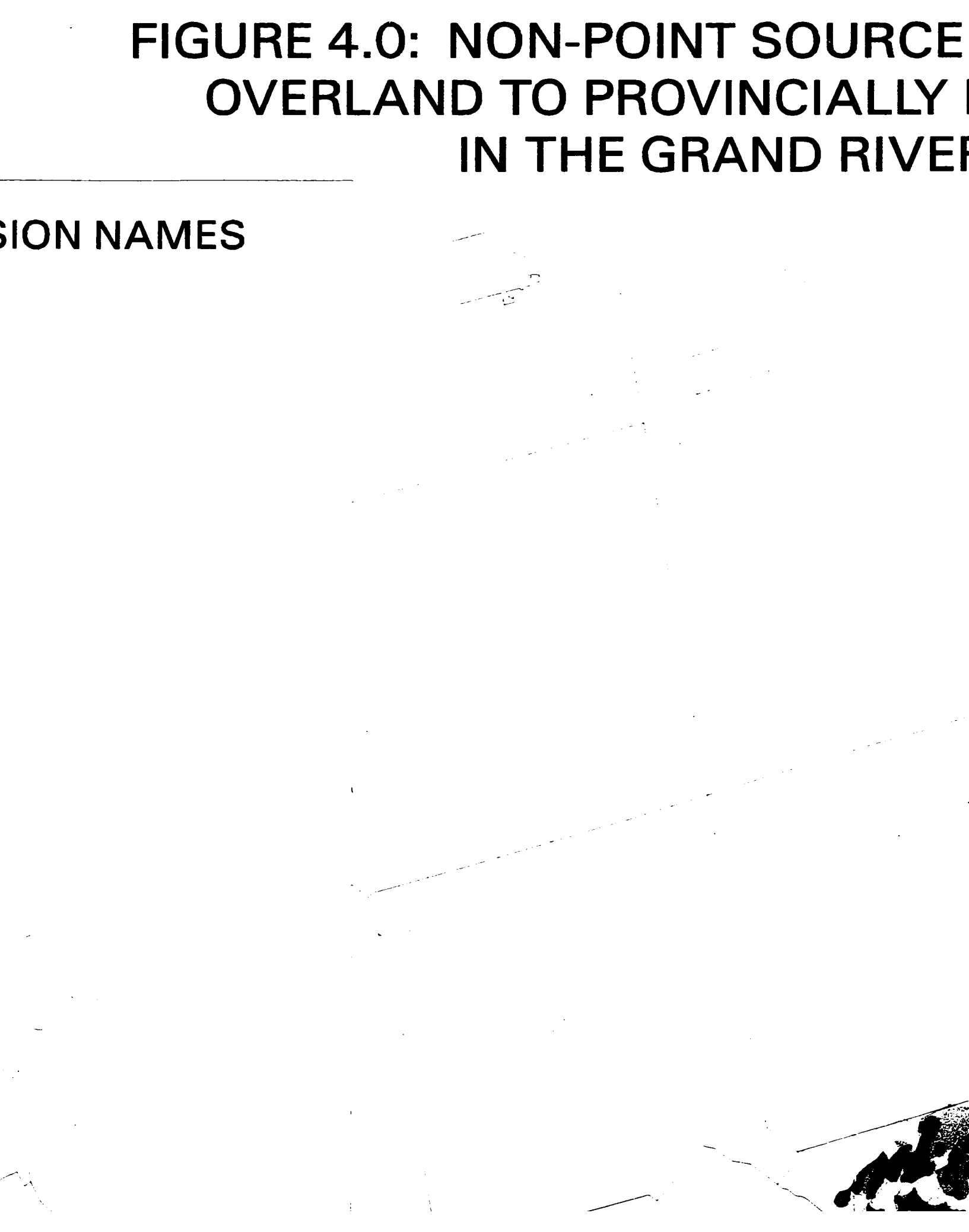
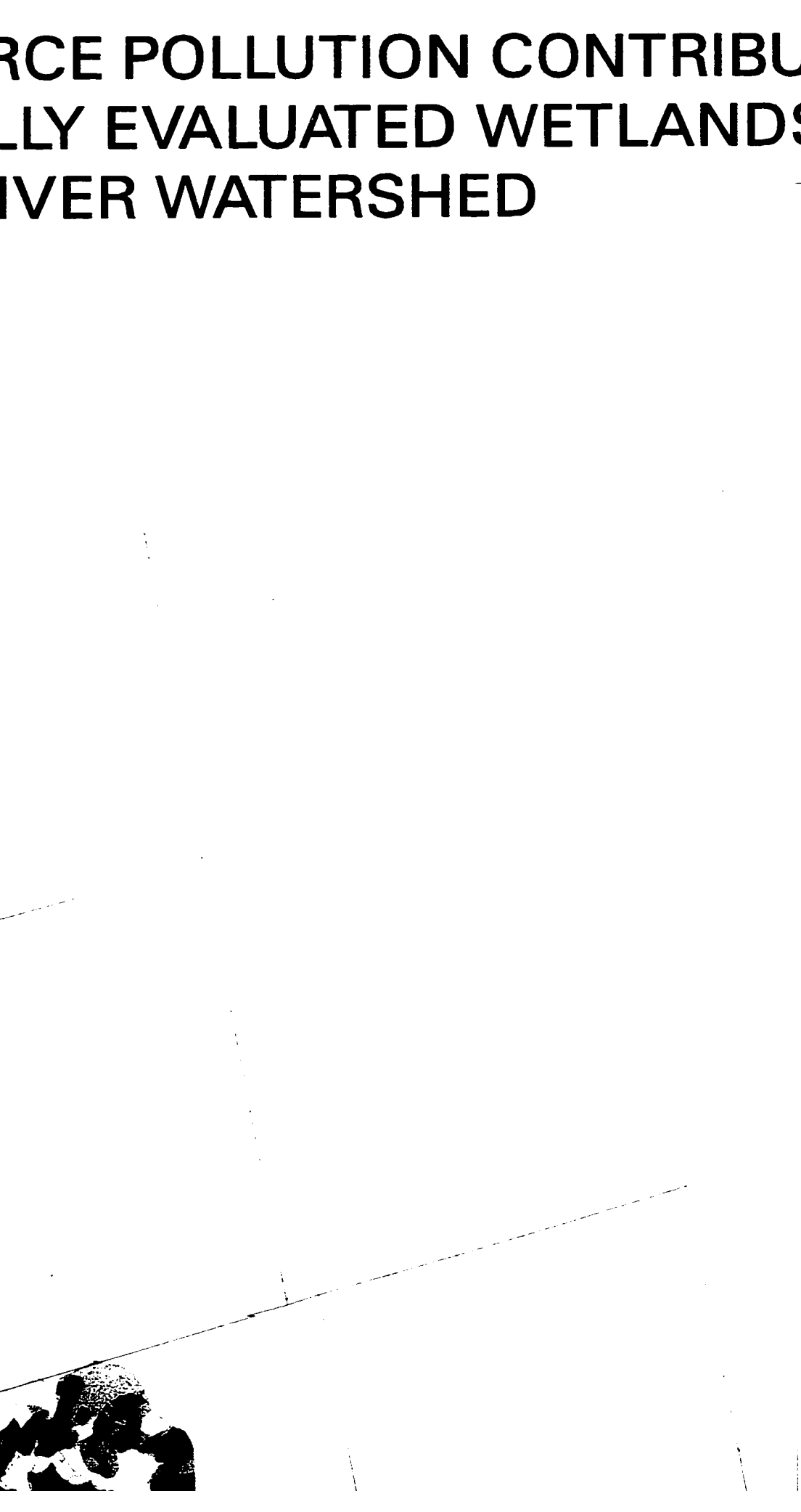


RCE POLLUTION CONTRIBUTED
LLY EVALUATED WETLANDS
IVER WATERSHED



LEGEND

Non-Point So

- High I
- Mode
- Low D

Hydrology

- Resev
- Wetla

Other Landus

- Built-
- Extrac
- Uncla
- Towns
- Roads

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LEGEND

Non-Point Source Pollution Delivery Classes

- High Delivery
- Moderate Delivery
- Low Delivery

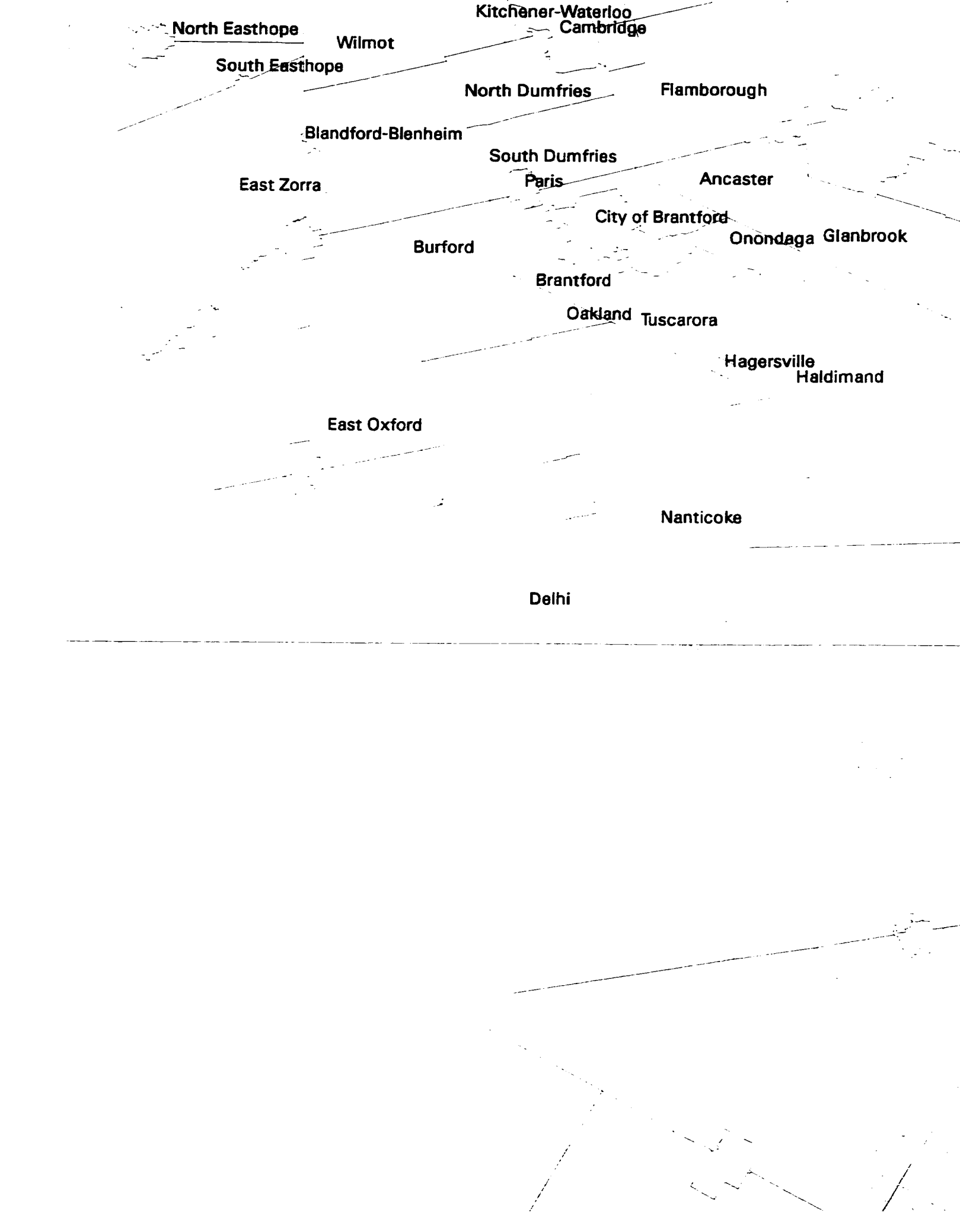
Hydrology

- Resevoirs & Rivers
- Wetlands

Other Landuse Classes

- Built-Up Areas
- Extraction Activity
- Unclassified
- Township Boundaries
- Roads

Notes: This map illustrates the use of GIS for integrating data from various sources to determine


Kitchener-Waterloo
Cambridge
North Easthope
Wilmot
South Easthope
North Dumfries
Flamborough
Blandford-Blenheim
South Dumfries
East Zorra
Paris
Ancaster
City of Brantford
Onondaga
Glanbrook
Burford
Brantford
Oakland
Tuscarora
Hagersville
Haldimand
East Oxford
Nanticoke
Delhi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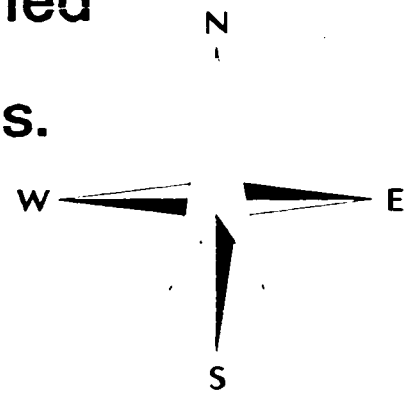
Notes: This map illustrates the use of GIS for integrating data from various sources to determine the overland contribution of non-point source pollution to provincially evaluated wetlands.

Source: Paley, M. 1997. Protection of Wetlands in the Grand River Watershed from Non-Point Source Pollution. A Masters Thesis.



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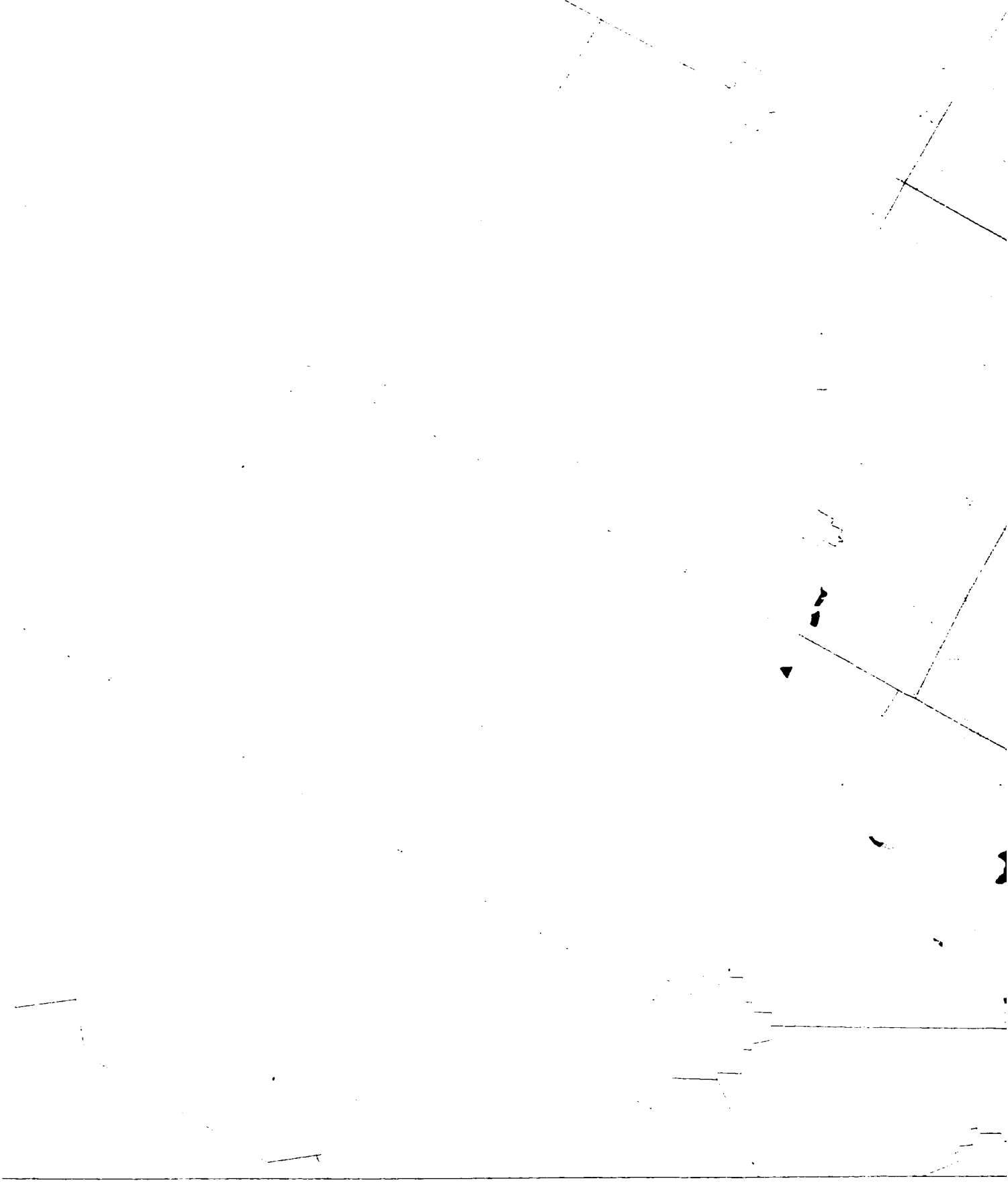
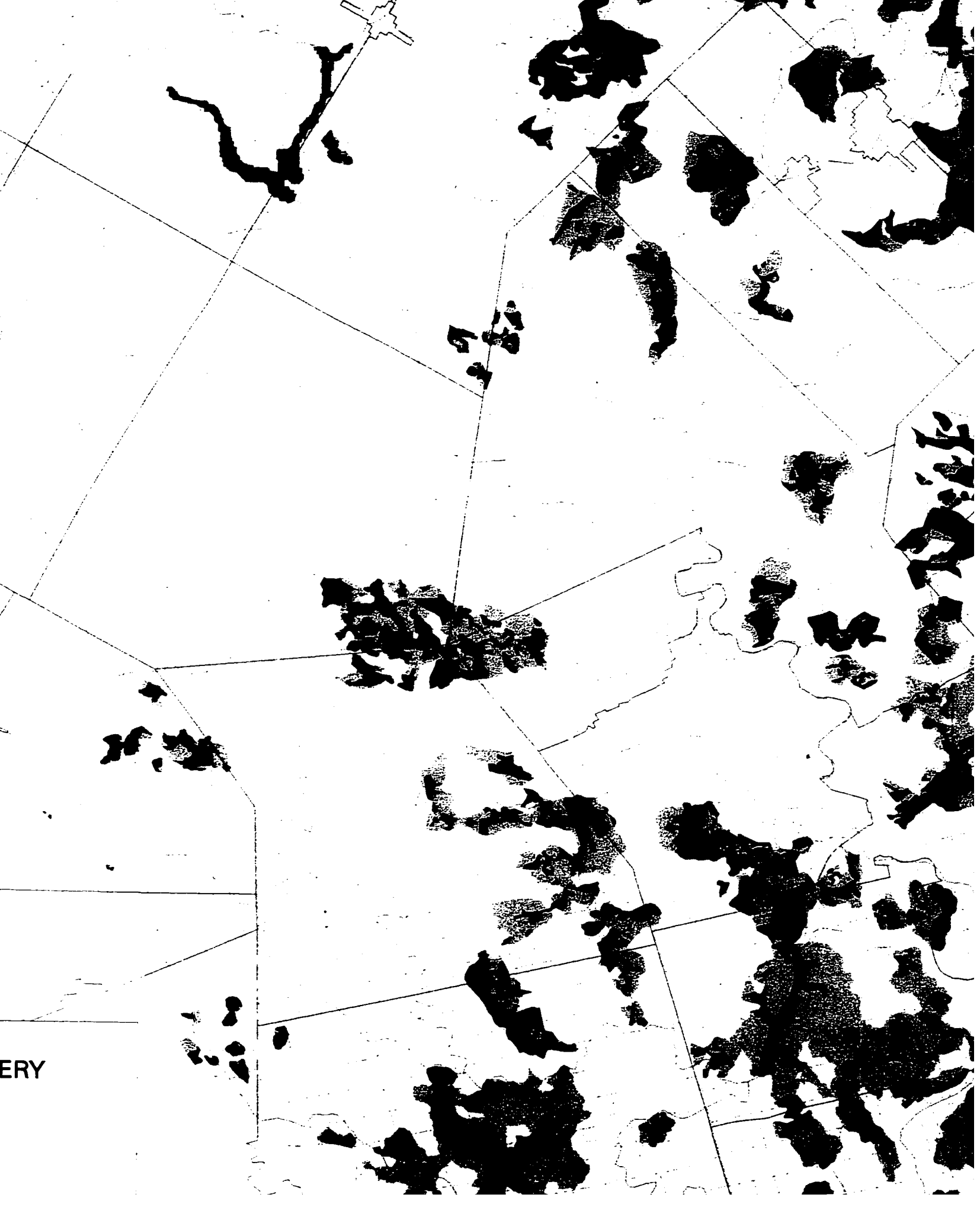


FIGURE 4.2: HISTOGRAM OF TOTAL AREA BY DELIVERY AND LANDUSE CLASS



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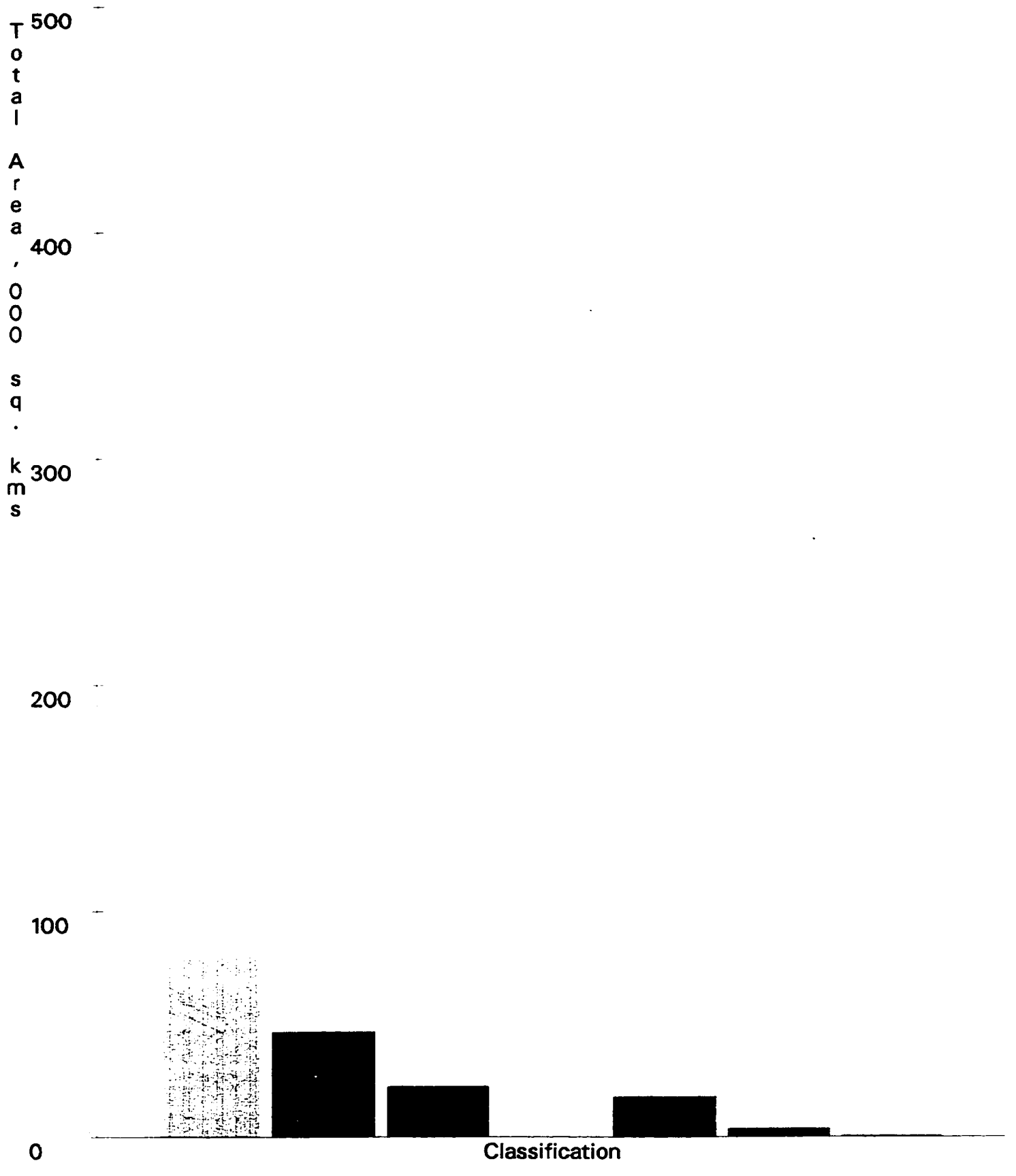

Total Area, 000 sq. kms
500
400
300
200
100
0
Classification

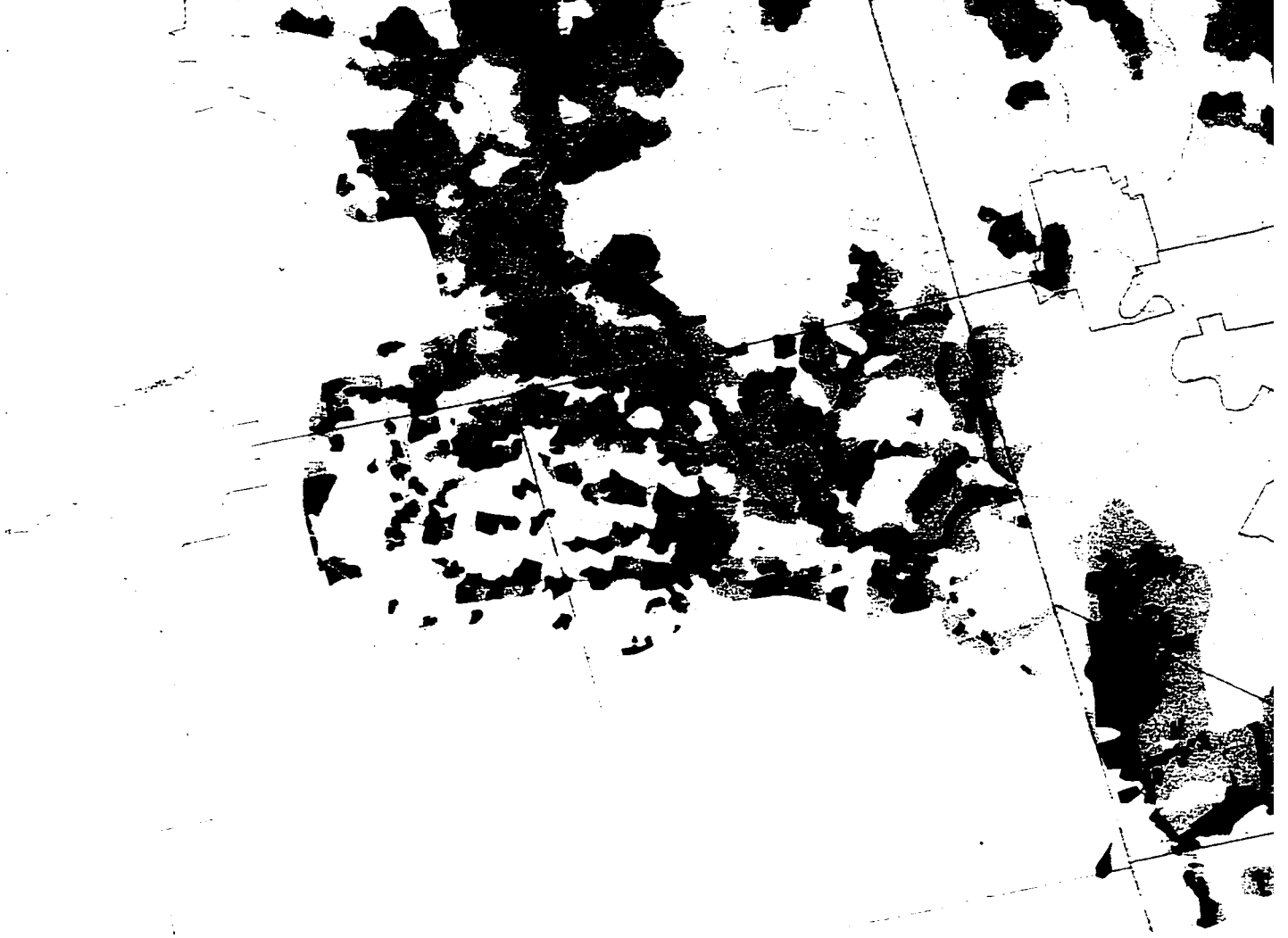
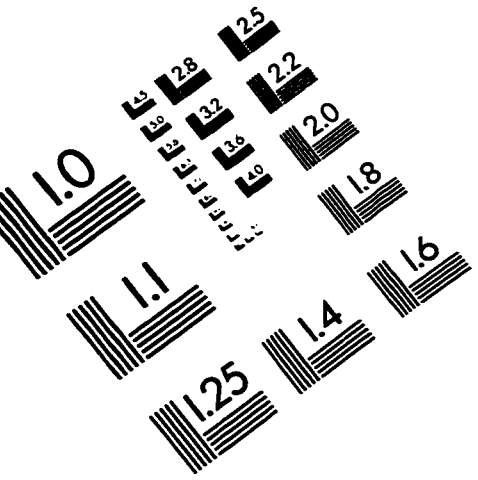
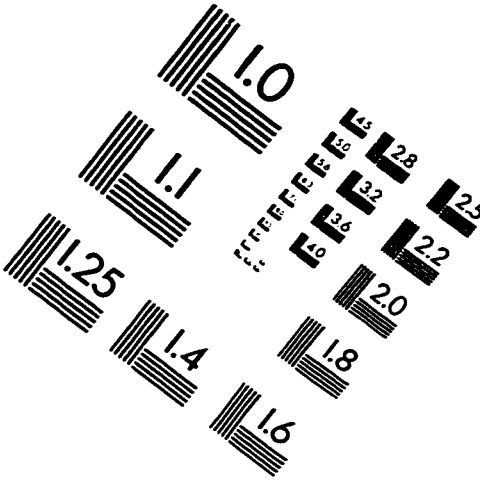
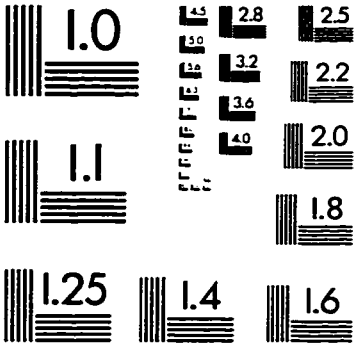
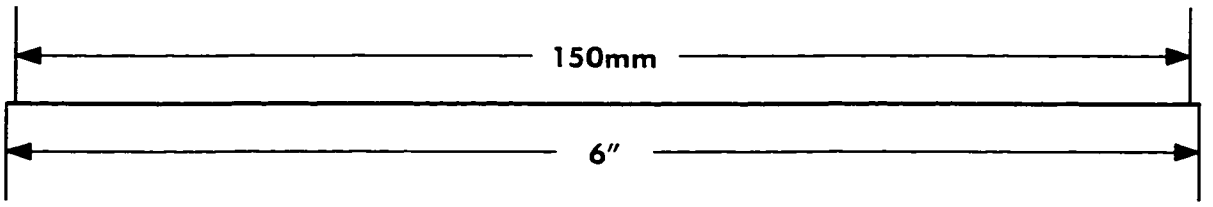


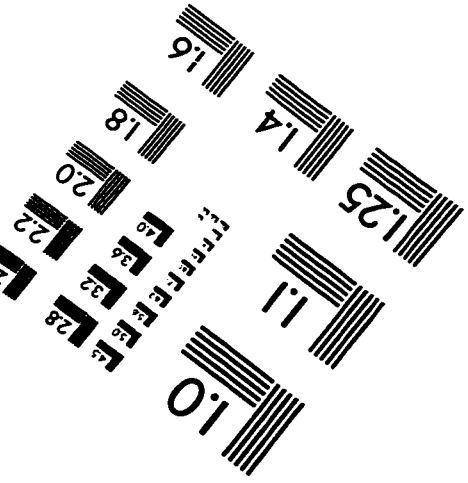
IMAGE EVALUATION
TEST TARGET (QA-3)











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